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Countdown for the New Basle Capital Accord

Are German Banks ready for the Internal Ratings-Based Approach?

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Abstract: This paper uses a unique data set from credit files of six leading German banks to provide some empirical insights into their rating systems used to classify corporate borrowers. On the basis of the New Basle Capital Accord, which allows banks to use their internal rating systems to compute their minimum capital requirements, the relations between potential risk factors, rating decisions and the default probabilities are analysed to answer the question whether German banks are ready for the internal ratings-based approach. The results suggests that the answer is not affirmative at this stage. We find internal rating systems not comparable over banks and furthermore we reveal differences between credit rating determining and default probability determining factors respectively.

Keywords: Default probability, Credit rating, Bank regulation.

JEL classification: G21, G33, G38

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1 Introduction

The corporate loan business of commercial banks suffers from decreasing margins and consequently a decreasing profitability of lending. Apart from operating costs unrelated to credit risk, lower margins are the result of high credit risk costs in the form of expected defaults and mandatory capital requirements to cover unexpected losses from lending activities. Minimum capital requirements currently amount to 8% of exposure. Despite the fact that actual negotiated credit terms are always characterized by a positive margin, these costs may therefore cause the bank to incur losses from its lending activities. A major reason for these losses are mandatory capital requirements completely unrelated to the actual credit risk incurred. In particular, a bank may suffer severe losses from those loans whose default probability would actually require a much smaller amount than the 8% specified by regulators to cover unexpected losses.

Since the disadvantages of risk–independent capital requirements have become obvious in recent years, the new Basle Accord places great emphasis on the reform of this particular area. An explicitly stated objective is to force banks to compute minimum capital requirements based on their internal estimations of default risk on the basis of the so called Internal Ratings–Based Approach (IRB).[1]

Typically, banks use a scoring–model to determine an individual loan's default probability. Based on past experience, checklists are used to place a weight on factors thought to exert an influence on default risk. These weights are then used to construct a score which summarizes the information contained in the respective factors. Sometimes, methods of multivariate discriminant analysis are employed to evaluate the borrower's balance sheet data. Altman's z–score model[2] is probably the most famous example for this approach. The resulting score is then placed within one of several rating categories. What the New Basle Accord now provides for, is the assignment of explicit default probabilities to these rating categories to determine the risk weight.

Even if the methods to construct rating systems differ markedly between banks, the ratings all try to capture the same measure, namely the probability of borrower default. Consequently, one would expect the ratings of the different rating systems to be similar with respect to the following properties: First, relations between borrower characteristics and the probability of default should be reflected in the ratings. Second, a statistical relation between the scores and observed default probabilities as the true variable of interest should exist. Hence, depending on whether high or low scores correspond to a more favorable rating in the respective bank's system, a more favorable score should be accompanied by a lower default probability. This paper raises the question whether the ratings in the corporate lending business of six leading German universal banks show these properties. In addition, we ask whether these observed rating systems meet the important minimum requirements specified by the New Basle Capital Accord.

Section 2 gives an brief overview on the New Basle Capital Accord and the minimum requirements for corporate exposures. In section 2.3 the questions are formulated, which are to be answered on behalf of an empirical analysis on the basis of credit file data described in section 3.

[1] See for more details Basle Committee on Banking Supervision (2001a).

[2] See Altman(1968) and Altman/Haldemann/Narayanan(1977).

2 Background

2.1 The New Basle Capital Accord

On January 16, 2001, the Basle Committee on Banking Supervision issued a revised version of its reform proposals for the new capital adequacy framework for banks to initiate another round of discussion. Compared to the earlier draft, the new version of the Basle Accord is much more specific. Because the details were worked out based on more than 200 comments received, the current version of the consultative paper has swollen to more than 500 pages. Interested parties such as banking or trade associations are now invited to submit their comments on this version until May 31. The definitive version is expected to be forthcoming at the end of the year, but it will probably not come into force before the year 2004.

The reform package comprises three pillars: the minimum capital requirements, a supervisory review process and disclosure requirements (market discipline). The last two are intended to motivate banks to engage in a continuing process of developing and improving their risk management capabilities. The minimum capital requirements are the core part of the reform. Though, the 8 percent minimum capital ratio for market and credit risk remains unchanged, major changes have taken place with respect to the risk weighting of individual assets in the banks' lending operations. The aim of the new proposals is to determine a reliable measure for the degree of risk at which a loan defaults.

The proposed rules for minimum capital requirements to cover credit risks had already unleashed a heated discussion, initiated by the German side, before the June 1999 draft was published. The first thoughts on reform only mentioned the standardized approach, which provides for an orientation on external ratings such as Moody's or Standard & Poor's for a more fine–tuned weighting of credit risk. There, the rating is used to derive a risk weight that determines the percentage of an asset representing risk capital to be secured by equity. A risk weight of 100 percent results in the exposure being secured with 8 percent of own funds, a risk weight of 50 percent results the credit sum being secured with 4 percent of own funds. The problem is that very few German companies have an external rating. According to the standardized approach, companies without an external rating are to be weighted at 100 percent, as they have been in the past; in other words, they are to be secured by the full 8 percent in capital. In Germany, it was feared that this would cause banks to grant loans primarily to companies that have an external rating or charge a much higher interest to companies lacking one. In particular, it was felt that this approach would entail severe credit access problems for small and medium sized firms that constitute the backbone of the German economy.

These complaints led to the additional adoption of the so–called "Internal Ratings-Based Approach" (IRB), which extends and in some cases supersedes the standardized approach: Instead of external ratings, this approach makes it possible for internal bank ratings to be used to determine the risk capital. What was originally proposed as an emergency solution, has become the declared objective of the entire reform package in the meantime.

Now the ball is back in the court of German banks. Developing sophisticated risk management tools has now become a major challenge for them because these are a pre-

condition for the IRB–approach. The same applies to regulatory authorities. This results from that fact that banks could now have a great incentive to manipulate their capital adequacy requirements with a suitable rating design. This is why the rating systems have to meet certain quality standards and these have to be supervised.

2.2 Minimum requirements for corporate exposures

The Basle Committee on Banking Supervision proposes two methodologies for calculating the capital requirements for credit risk: One alternative will be to measure credit risk in a standardized manner, the other methodology would allow banks to use their internal ratings. The Committee provides for a basic and an advanced internal ratings–based (IRB) approach. The basic approach comprises a switch from external ratings to internal assessments of the borrowers' quality. Consequently, its use by banks requires meeting robust supervisory standards. Estimates of additional risk factors, such as losses incurred by the bank given a default and the expected exposure at default, will be computed by the application of standardized supervisory estimates. For banks that meet more rigorous supervisory standards, the advanced IRB approach will be available. Under this approach, the additional risk components mentioned above will also be estimated internally by the bank.[3]

Another problem resulting from the IRB approach is the consistency of the rating system over time and across banks. This is (an additional reason) why the rating systems employed have to meet certain quality standards and therefore have to be supervised. These minimum requirements should ensure the integrity and credibility of a bank's rating system and its estimation of the risk components. They address among other things a meaningful differentiation of credit risk, the completeness and integrity of rating assignment, an oversight of the rating system and provide directions on criteria of the rating system, in particular how to estimate the probability of default and the interaction with other risk factors.

We focus on the IRB approach for corporate exposures, since they are the main topic of the current controversial discussions. For a bank the first step on the way to the advanced IRB approach is the estimation of the borrower's probability of default (PD) within the basic form of the IRB approach. Regarding this, the following minimum requirements are of importance.

2.2.1 Data collection

Requirement: The Committee proposes three specific techniques for estimating and analyzing the probability of default.

1. A bank may use data on internal default experience.

2. The use of pooled data across institutions will also be considered acceptable.

[3]See for more details Basle Committee on Banking Supervision 2001a, 2001b and 2001c, available on the web page of the Bank of International Settlements http://www.bis.org.

3. In addition to that, the use of mapping techniques will also be accepted. Banks are allowed to assign a PD to each internal grade or mapping their internal grades to the scale used by an external credit assessment institution.

Critical remark: The bank's historical databases often lack enough default observations for meaningful statistical inference since borrower defaults are fortunately relatively rare. Mapping techniques on the other hand are also problematic because the clientele of rating agencies is – especially in Germany – different from typical banks' borrowers. Hence pooling data from different banks seems to be the most promising alternative. In order to do this, however, the bank must demonstrate that the population of borrowers represented in the data is representative for the population of the banks' actual borrowers. Additionally, a bank must demonstrate that the internal rating systems and criteria of other banks in the pool are comparable with its own.

2.2.2 Default definition

Requirement: Probabilities of default are comparable over banks only if they use the same definition of default. In accordance with the Committee's recommendations, a default is considered to have occurred when one or more of the following events has taken place.[4]

1. It is determined that the borrower is unlikely to pay its debt obligations like principal, interest, or fees in full.
2. A credit loss event has occurred associated with any obligation of the obligor, such as a charge–off, specific provision, or distressed restructuring involving the forgiveness or postponement of principal, interest, or fees.
3. The obligor is past due more than 90 days on any credit obligation.
4. The obligor has filed for bankruptcy or similar protection from creditors.

Critical remark: With the exception of the first point these definitions appear sound. The events are objectively observable and are documented in this way in banks' credit files. The first formulation, however, is really a description of what one tries to estimate, hence this point is problematic. This formulation should therefore be removed from the definition.

2.2.3 Risk factors

Requirement: To meet the requirements, the bank must demonstrate that its criteria cover all factors that are relevant to the analysis of borrower risk. These factors should (i) demonstrate an ability to differentiate risk, (ii) have predictive and discriminatory power, and (iii) be both plausible and intuitive in order to ensure that ratings are designed to distinguish risk rather than to minimize regulatory capital requirements.[5]

[4] See Basle Committee on Banking Supervision 2001a, paragraph 272.
[5] See Basle Committee on Banking Supervision 2001a, paragraph 264.

Critical remark: The ability of factors to differentiate risk and their predictive and discriminatory power could be checked on the basis of sufficiently informative historical data. The third requirement, namely that factors should be both plausible and intuitive is important for the rating system's acceptance. This objective can be achieved for instance by deriving the factors from theoretical models. In Chapter 3 possible risk factors and their connection to theoretical models are represented.

Requirement: All relevant information should be taken into account in assigning ratings to a borrower. The Committee requires that as a minimum, a bank should look at each of the following factors for each borrower:[6]

1. historical and projected capacity to generate cash to repay its debts and support other cash requirements, such as capital expenditures required to keep the borrower a going concern and sustain its cash flow;

2. capital structure and the likelihood that unforeseen circumstances could exhaust its capital cushion and result in insolvency;

3. quality of earnings, that is, the degree to which its revenue and cash flow emanate from core business operations as opposed to unique and non–recurring sources;

4. quality and timeliness of information about the borrower, including the availability of audited financial statements, the applicable accounting standards and its conformity with the standards;

5. degree of operating leverage and the resulting impact that demand variability would have on its profitability and cash flow;

6. financial flexibility resulting from its access to the debt and equity markets to gain additional resources;

7. depth and skill of management to effectively respond to changing conditions and deploy resources, and its degree of aggressiveness vs. conservatism;

8. its position within the industry and future prospects; and

9. the risk characteristics of the country it is operating in, and the impact on the borrower's ability to repay, (including transfer risk) where the borrower is located in another country and may not be able to obtain foreign currency to service its debt obligations.

Critical remark: These suggestions and their link to the literature will be discussed in Chapter 4 where the variables for the empirical analysis are developed.

[6] Original wording of the Basle Committee on Banking Supervision 2001a, paragraph 265.

Requirement: If a formal statistical model is used, the variables must have statistical power and the model should capture all key variables. Those variables not considered in the model should be addressed and focused on in the risk assessment conducted by expert personnel.

Critical remark: The consideration of qualitative and thus mostly subjective information in a statistical model is difficult. In a discriminant analysis for example, it is not possible, because qualitative variables are not normally distributed. In addition, the more subjective information is considered in the ratings, the more suffers the comparability. There is a trade off between the degree of evaluation and the degree of consistency. Furthermore, empirical studies (including this one) show that only a few variables are significant, which suggests that a lot of risk factors seem not to have enough discriminatory power. The question is whether and how these factors should be considered in a rating system. Most banks aggregate qualitative information in an informal way and include the aggregated score as a subrating. Brunner, Krahnen and Weber (2000) were able to show that the set of qualitative factors is not simply redundant with respect to publicly available accounting data and tends to be decisive in several cases. It tends to improve the firms' overall corporate rating. They pointed out that the more restrictive the weighting scheme as part of the rating methodology, the stronger is the impact of qualitative information on the firms' overall rating.

2.3 Questions to be answered

The countdown for the New Basle Capital Accord is running. The definitive version is expected to be forthcoming at the end of the year 2001. Application of the Accord will become mandatory in the year 2004, therefore banks have less than three years preparation time. Hence the overall question to be answered is the following.

> *Are German banks with their currently used rating systems ready for the internal ratings–based approach?*

To answer this question, a detailed analysis of the relation between potential risk factors, the ratings and the borrower's probability of default is necessary. Despite the formal details of the different rating systems, they all try to measure the same variable of interest: the quality of the borrower. This leads to the following additional questions.

> **Question 1** *Is the assessment of the borrower's quality – represented by the internal rating – driven by the potential risk factors outlined before and which effect have the different sources of the ratings on the relation between risk factors and rating?*

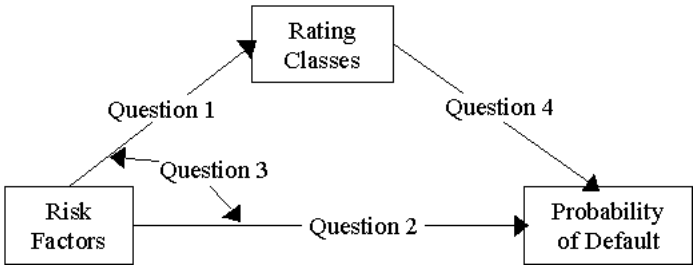
> **Question 2** *Do we find a relation between the potential risk factors and the probability of default?*

> **Question 3** *Does the relation between risk factors and the probability of default bear any resemblance to the relation between risk factors and rating and where do possible differences between both relations come from?*

Question 4 *Does the rating predict the probability of default and which effect have the different sources of the ratings on the relation between ratings and the probability of default?*

We try to answer the questions by performing a statistical analysis on the basis of pooled credit risk experience from six German banks. Figure 1 illustrates the analyzed relations and the resulting research objectives.

Figure 1: Relations between risk factors, ratings and the probability of default.



3 Data

In our study we use the data set of a research project on credit management in Germany that was initiated by the Center for Financial Studies (CFS) in Frankfurt. Data from credit files of 260 medium sized firms including banks' internal borrower ratings were pooled over six leading German universal banks.[7] This section presents an overview of basic information on the data collection process to facilitate the understanding for the specific research questions addressed by this paper.

The research project was restricted to medium–sized firms with annual sales volumes between 50 and 500 millions DM. The sample comprises a randomly chosen cross–section of 260 borrowers over the seven years between 1992 and 1998 and includes an oversampling of potentially distressed firms. One of the criteria for inclusion in this subset is at least one negative rating (rating 5 or 6) by the borrower during the observation period.

The complete credit files of each borrower served as the basis for the sample data collection. This information was supplemented by additional information on the borrower provided by different electronic data processing systems of the respective bank. Apart from the bank's internal rating, the data includes information on the terms of credit under current account, investment credits, discount credits, credit by way of bank guarantee, and other credits, including all kinds of collateralization.

These data are further complemented by some firm characteristics such as the legal form, branch of business, and important data taken from the firms' annual reports. In

[7] Bayerische Vereinsbank, Deutsche Bank, Commerzbank, DG Bank, Dresdner Bank, and West LB.

Table 1: Descriptive Statistics

	Total Assets*			Sales*			Equity Ratio**		
Rating	Mean	Std.Dev.	Obs.	Mean	Std.Dev.	Obs.	Mean	Std.Dev.	Obs.
1	85 163	71 805	33	179 232	121 893	33	37.18	16.13	33
2	155 964	306 659	132	172 956	122 726	132	31.58	16.41	132
3	466 379	5 339 071	272	179 763	215 907	271	22.89	14.15	272
4	117 420	159 290	309	178 607	235 272	309	15.64	11.85	309
5	127 493	178 228	205	152 695	150 151	203	13.27	12.69	205
6	114 215	130 401	59	122 081	110 337	59	7.83	13.91	59
Total	217 238	2 776 104	1 010	169 663	193 309	1 007	19.44	15.37	1 010
	Return on Total Assets**			Cash Flow Ratio**			Coverage Ratio**		
Rating	Mean	Std.Dev.	Obs.	Mean	Std.Dev.	Obs.	Mean	Std.Dev.	Obs.
1	19.07	18.45	33	66.73	60.19	33	185.00	145.01	33
2	14.93	13.59	131	59.04	53.05	130	149.15	92.97	128
3	9.01	7.58	271	29.57	33.35	270	184.81	397.45	266
4	5.40	10.20	309	16.51	25.89	307	181.58	230.73	294
5	2.77	11.47	205	10.32	25.04	203	138.35	198.39	199
6	1.77	12.17	59	4.85	17.37	58	165.25	340.90	59
Total	7.31	11.71	1 008	25.28	37.82	1 001	168.56	275.30	979
	Obligo*			Engagement**			Spread***		
Rating	Mean	Std.Dev.	Obs.	Mean	Std.Dev.	Obs.	Mean	Std.Dev.	Obs.
1	15 193	19 535	36	50.65	33.52	34	3.05	0.96	35
2	17 649	17 896	137	53.36	27.88	125	3.20	1.02	114
3	16 338	15 087	279	64.48	41.56	248	3.38	1.12	210
4	15 378	20 133	318	73.82	32.30	279	3.62	1.26	221
5	15 044	14 665	203	82.85	35.23	176	4.05	1.83	142
6	16 941	14 421	59	138.58	219.66	57	3.83	2.44	45
Total	15 956	17 199	1 032	73.40	66.95	919	3.56	1.43	767

* thousand of Deutsche Mark / ** percent / *** percent points

those cases for which a credit decision or investigation was documented for a borrower, all variables of interest were collected.

To avoid a survivorship bias, the sample's population had to include all borrowers who matched the sampling criteria at some time during the observation period. For this reason, some relationships started in the years after 1992.

The rating (R12, R3, R4, R5, R6) reflects the bank's individual evaluation of the borrower's risk and is essentially a compact and comprehensive measure of various quantitative and qualitative factors (e.g., the quality of the management, the market position of the firm and its future prospects). The ratings do not consider the terms of the credit contracts like covenants or collateral.[8]

The five participating banks' respective internal rating systems are not homogeneous. Therefore, we had to transform the individual rating systems into a uniform scheme. Elsas et al (1998), p. 22 illustrate this transformation scheme. We constructed a system comprising six categories: 1 equals very good, 2 equals good/above average, 3 equals average, 4 equals below average, 5 equals problematic borrower, and 6 equals loan in danger/loss of loan. The variable R12 reflects categories 1 and 2, and variables R3 to R6 represent the categories 3 to 6. For one of our analyses we aggregate the six rating categories in three. Therefore we summarize the categories 3 and 4 to R34 and 5 and 6 to R56. Table 1 shows some descriptive statistics for the ratings.

[8]Elsas/Krahnen (1998), Ewert/Schenk/Szczesny (2000) and Machauer/Weber (1998) analyze relations between collateral, covenants and other characteristics of the bank–borrower relationship.

4 Embedding the variables

The Basle Committee's minimum requirements have specified a number of potential risk factors (see chapter 2.2.3) and require them to be both plausible and intuitive. To act in accordance with this requirement it would be desirable to embed the factors in the available literature on firms' credit risk and on firm survival. The literature on firms' credit risk is mainly concerned with the creditworthiness of firms, usually from a credit analysts' perspective.[9] In contrast, the literature on firm survival takes the view of an economic policy maker and tries to describe the mechanism determining firms' market exits.[10]

Following the enumerated requirements in chapter 2.2.3 we work out the independent variables for our empirical analysis. Subsequently, the dependent variables and the statistical methodology used are described in section 5.1.

(to item 1.) The first item of the proposed risk factors concerns the firm's capacity to generate cash to repay its debts. The return on total assets RT (defined as the ratio of the firm's earnings to the balance sheet total) is a rough measure for a firm's earning power and profitability and should therefore be included in the analysis.[11] It is expected that this variable is negatively related to the probability of default. Hence it should also be negatively related to the rating classification. The cash flow ratio CF (defined as the ratio of cash flow to the firm's total debt) is another indicator for the firm's ability to repay its debts.[12] The higher the ratio, the lower one would expect the distress probability to be. The ratio is the reciprocal value of the so–called dynamic leverage ratio which describes the number of years that are needed to repay the total debt obligations by using the firm's cash flows.

(to item 2.) The second item concerns the capital structure of the firm. Theoretical models of capital structure[13] predict that the default probability of firms with a low equity ratio EQU (defined as the ratio of equity to the firm's total assets) is – ceteris paribus – higher than the default probability of firms with a high equity ratio. The identity of maturities proposes to use the coverage ratio for long term assets CLTA (given by (equity + long–term debt)/(long–term assets)) as an indicator for a viable capital structure. The higher this ratio the lower the distress probability should be.

(to item 3.) Another suggested risk factor is the quality of earnings with regard to the core business of the firm. Regardless of the fact that this information is not contained

[9] Based on early works of Altman (1968), Beaver (1968) and Ohlson (1980) or Merton (1974) and Sharpe (1964).

[10] One can distinguish theory about organizations like the population ecology of organizations based on works of Stinchcombe (1965), Hannan/Freeman (1977 and 1989) or Brüderl/Schuessler (1990) and the theory of industrial economies as organizational learning in the tradition of Jovanovic (1982), theory of market structures by Porter (1979) or game theory as in Fudenberg/Tirole (1992).

[11] This measure was already in Altman (1968) one of the ratios which discriminated well.

[12] This measure can already be found in the basic work of Beaver (1968).

[13] See for example Kraus/Litzenberger (1973).

in our data set, this assumption's theoretical foundation is by no means obvious. On the one hand, there exist a lot of firms that have pursued the strategy of spinning off non-core business units in order to focus on their core competence and mission. Other firms have chosen an opposite strategy of diversification, however. In the theoretical model of Jovanovic (1993) diversification increases market power, eliminates risk, facilitates access to financial resources and leads to efficiency gains in production. Empirical evidence on this topic is rare and the results are not supporting this model. Berger and Ofek (1995) for example find a negative effect of diversification on firm value and firm profitability. Lang and Schulz (1994) found a negative effect on the firms' Tobin's q. Both studies concern American firms. For the German market Harhoff et al. (1998) found no significant effects of diversification on firm survival. Kaiser (2001) has identified a negative effect of diversification on the probability of a transition starting from the 'no financial distress' state to a 'financial distress' state.

(to item 4.) The quality and timeliness of information about the borrower, including the availability of audited financial statements is an important source of information concerning the quality of the borrower. It is intuitive that a borrower in financial distress has difficulties to provide flawless documents, which would guarantee the bank's financial support in the future. In our dataset, there are no remarks about the quality of the information submitted by the borrower. Concerning the timeliness we can construct a proxy variable, since for a number of borrowers we are able to compare the examination date of the credit file with the date of the submitted financial statements at the time of the credit decision. Test estimations have shown that this indicator seems to have predictive and discriminatory power regarding the probability of default. Unfortunately the number of observations with trustworthy information about the delay is too small to include it in our empirical study.

(to item 5.) The degree of operating leverage is captured by the equity ratio EQU.[14] It is hypothesized that equ has a negative impact on the probability of default.

(to item 6.) Information about financial flexibility, interpreted as a firm's ease of access to the debt and equity markets is not easy to evaluate. Two possible indicators for such a measure may be the age and the size of the firm. One might hypothesize that with increasing age and size firms are getting more firmly–established in their respective markets and their market power therefore increases which would facilitate access to the debt and equity market. Aditionally, larger firms are typically able to pledge more collateral which would make it easier to obtain external finance. On the other hand, monitoring costs also increase with firm size. Taking together, this leads to the hypothesis that firm size has an U–shaped effect on the probability of default. Another reason to include a size indicator has its early source in Schumpeter (1964) who stressed a large firms's innovation advantage. It is also the rationale behind a theoretical model by Jovanovic and MacDonald (1994) describing the role of innovations. They show that major process innovations

[14] The equity or debt ratios are intuitively predictors for insolvencies and therefore have a long tradition, see for example Beaver (1968) or Altman (1968).

are challenging/difficult to adopt for small firms and hence might force them to exit. The model was tested for American firms and appears to fit reality well.

The reasons to include age as an indicator for the probability of default can be found in theoretical models which focus on the life cycle of firms. Jovanovic (1982) has developed a theory of firm growth and exit in which firms uncover their true efficiencies over time following a Bayesian learning process. Pakes (1998) has shown that many functional specifications of Jovanovics' model imply that it takes time for entrant firms to acquire sufficient information about productivity parameters before they are able to decide whether to exit or to stay in the market. This model's prognosis for liquidation is therefore that risk of liquidation first increases and then decreases as the entrant firm's beliefs in its own productivity are updated and improve in precision. These hypotheses can also be found in the theory of population ecology. The liability of newness hypothesis[15] states an decreasing probability of default with increasing age. Beyond this, the liability of adolescence hypothesis[16] assumes that risky firm foundations could in the early time after their foundation gain from initial recourses and trust viewed as an initial asset. According to this theory, one would expect mortality rates to increase to a maximum, and decline afterwards. For these age effects a lot empirical evidence is available for the German market. For example see the works by Anders and Szczesny (1998), Brüderl, Preisendörfer and Ziegler (1992) as well as Harhoff et al. (1998).

We include age and size taking possible nonlinear effects into account. Size LN_TA is defined as the natural logarithm of firm size as proxied by the amount of total assets and its square (LN_TA_2). Since we don't have information about the respective founding dates, we use the duration of the bank–customer relationship as a proxy for the age of the firm. LN_AGE and LN_AGE_2 are the two used variables.

(to item 7.) Numerous authors have shown that the assessment of management skills and the resulting degree of aggressiveness vs. conservatism have an important effect on firm survival.[17] Our data set does not include standardized information about the respective firms' human resources, since the assessment of management skills is subjective and therefore difficult to standardize. Some of the considered banks have a subrating for the judgement of management quality, however. One possible indicator for the degree of aggressiveness versus conservatism is the firm's status with respect to owners' limited liability. Limited liability has been documented to provide incentives to pursue more risky strategies than would be the case under unlimited liability.[18] Newer literature links the choice of legal form to transaction cost theory. Limited liability enables entrepreneurs to reduce personal risk at a comparatively higher cost resulting from taxation, auditing requirements and fees. Empirical evidence shows that limited liability leads to a higher probability of default. See for example Horvath and Woywode (1997), Harhoff and Stahl (1995) and Harhoff et al. (1998).

[15] See Stinchcombe (1965) and Hannan and Freeman (1984).

[16] See Brüderl and Schüssler (1990) and Brüderl, Preisendörfer and Ziegler (1924).

[17] See for example Audretsch and Vivarelli (1993), Bates (1990), Hannan and Freeman (1989) or for the German market Brüderl/Preisendörfer/Ziegler (1992)

[18] Stiglitz and Weiss (1981) have shown this to be the case in the context of an adverse selection and moral hazard model.

(to item 8.) The firm's position within the respective industry and its future prospects are often considered in a subrating commonly called "market position". Since not all banks have such subratings, we could not explicitly include this potentially relevant information in our empirical study. A theoretical basis for such effects can be found in the basic argument of organizational ecology in which the organizational selection processes are mainly driven by environmental forces. One environmental factor is for example the competition, another is the type of industry. Concerning the latter we were in a position to include some dummy variables for possible industry effects. The dummies MANUF (manufactury), CONSTR (construction), TRADE (trade), OTHER (other industries, mainly services) are considered with machinery as reference category.

(to item 9.) As a proxy for risk characteristics of the country the firm is operating in, country ratings of external rating agencies could be used. In our data set a dummy variable EXPORT gives us information about the importance of exports to other countries for the respective firms, but we do not know the main country where the exports go to. Many empirical studies have found significant macroeconomic effects on survival. Audretsch and Mahmood (1995) for example have shown for U.S. credit rating data that significant business cycle effects on firm survival do indeed exist. In our study possible macroeconomic effects are considered by dummy variables for the years 1993 to 1998 (Y1993,..,Y1998) with the year 1992 as reference.

Additional risk factors: To complete our analysis we have to include additional risk factors. The different sources of the ratings are considered by means of dummy variables B2 (bank 2) to B6 (bank 6) with bank 1 as reference categorie. We include a factor INDEP wich indicates whether a firm is independent or part of a group of companies (Konzern).

A housebank relationship or the bank as board member possibly reduce the information asymmetry between lender and borrower and should therefore have an effect on the rating decision. The closeness of the relationship between firms and banks makes it possible for banks to price the default risk of firms in a more accurate way.[19] Fried and Howitt (1980) and Berger and Udell (1995) argue that banks could offer insurance services when general interest rate levels are high, or to firms in financial shortage. Earlier research on the same data used in this paper have shown, that housebanks do provide liquidity insurance in situations of unexpected deterioration of borrower ratings (Elsas and Krahnen (1998)). Ewert, Schenk and Szczesny (2000) show, that for low quality borrowers the advantage of housebank relationships is considerable. Banks are likely to help firms in financial distress, expecting future earnings because of their housebank status. Taking together these arguments lead to the hypothesis that firms in a close bank–customer relationship should have a lower default probability. Hence we include the dummy variables HB and BOARD to control for the effects described above.

[19] Theoretical arguments can be found, for example, in Diamond (1989, 1991).

5 Empirical Analysis

5.1 Methodology

To gain some insights into the questions formulated in chapter 2.3 we employ special statistical methods.[20] Three analyses are conducted: (i) the relation between risk factors and rating, (ii) the relation between risk factors and the probability of default and (iii) the relation between ratings and the probability of default. A common feature of the estimations is that the dependent variable is qualitative.

In case (i) the dependent variable RATING is polychotomous. This means that the variable has more than two possible outcomes. In order to receive a sufficient number of observations in each class, the six rating classes were aggregated into three. Since the categories follow a natural order which could be viewed as resulting from a continuos, unobserved measure called creditworthiness, an ordered logit or probit model should be used in this case. The estimation is undertaken by maximum likelihood, with the vector of explanatory variables being estimated in conjunction with estimation of the unknown boundary values defining the ranges of the rating categories. We choose the ordered probit model.

In case (ii) the dependent variable is dichotomous: In case of a borrower's default the dependent variable DEFAULT has the value 1, in case of no default the value is 0. A default is defined as the occurrence of one or more of the following events: (1) Prolongation of repayments, (2) utilization of collateral by the bank, (3) valuation adjustments of the bank's claims, (4) initiation or planning of restructuring activities by the bank, (5) rescue operations, (6) termination of the bank's commitment and (7) initiation of formal insolvency proceedings. The estimation results of such a model can be interpreted as the probability of default, which is limited by the values 0 (0 percent) and 1 (100 percent). As basis serves the entire obligo of the customer, since we want to estimate the borrower's default probability. Usual regression techniques are not valid in this case, since they entail a possibility to estimate probabilities outside the range [0,1]. Nevertheless, the so–called linear probability model is often used because of its computational ease. Logit or probit models, however, are definitely the more appropriate technique in this special case and we decided in favor of a probit model. The estimation is undertaken by maximum likelihood.

In case (iii) the dependent variable and the used statistical methodology is the same as in case (ii). A probit model is estimated in order to analyze the relation between ratings and the probability of default[21].

Specification tests for possible nonnormality and heteroskedasticity of disturbances were performed. The hypothesis that the disturbances are homoskedastic had to be rejected.[22] Ignored heteroskedasticity of the data is a serious problem and leads to wrong estimates of the coefficients in logit and probit models. Therefore an additional variance function is added to the probability function to control for heteroskedasticity.[23] For an

[20] See for further technical details of the methods described in this chapter Kennedy (1998), Maddala (1983) or Greene (1997). A discussion of the methodology in an application on credit risk Kaiser/Szczesny(2001).

[21] The probability of default considers the time period of the following year.

[22] See for the performed test Chesher und Irish (1987).

[23] See for an overview of heteroskedasticity as a specification problem Kennedy (1998), Chapter 8 and

interpretation of this phenomenon see chapter 5.2. All estimations are performed using sampling weights to control for the oversampling of potentially distressed borrowers.[24]

5.2 Results

To gain some insights into the overall question, namely whether German banks are ready for the internal ratings–based approach, three models have been estimated. Table 2 shows the results of the first two models. Additional Wald tests for joint significance of several variables and measures for the goodness of fit are shown in tables 3 and 4. The number of observations shown in table 4 differs from model 1 to model 2. For a huge number of firms we have more than one observation per year and whereas all these observations are considered in model 1, model 2, considers only one observation per year, since the Basle Accord requires a one year time horizon for default probabilities. All default events are therefore cumulated over this one year horizon.

Model 1 concerns the relation between the potential risk factors and the rating decisions aggregated in three classes with class 3 containing potentially distressed firms. Model 2 however tries to explain the relation between risk factors and the probability of default. Since the rating classification could be viewed as resulting from a continuos, unobserved measure called creditworthiness, one would expect the effects to be the same. As the results indicate, this is clearly not the case.

Size has no effect on the rating decision (the probability of default). The wald test on joint significance underlines that result. Therefore our results do not support the hypothesis of the U–shaped size–effect. Likewise, age effects appear to play no role in the ratings. Contrary to this finding, age has a significant inverted U–shaped effect on the probability of default in model 2. Hence size and age of a firm are not fully independent in the sense that young firms are mostly small firms. Conseqeuntly, both effects have to be interpreted together. Figure 2 illustrates that the liability of adolescence is clearly recognizable for small firms whereas for larger firms the effect nearly disappears. At this point one has to remember that the duration of the bank–customer relationship was used as a proxy for firm age. In case of larger firms this approximation is questionable which provides a good explanation for the disappearing age effect.

This difference between model 1 and model 2 suggests that there is room for possible improvements of the rating systems.

Whether a firm is independent (INDEP) or part of a group ("Konzern") affects the rating decision. For their rating decision, banks evidently take into account that group firms are secured by liability promises from other companies in the group (mainly from the parent company to a subsidiary). Surprisingly, this finding is not supported by model 2. During the observed time period, group firms did not display a significantly lower probability of default than independent firms. This may be attributable to the fact that the "deeper pockets" argument for group firms appears intuitive at first glance, but is not necessarily supported by theoretical work on groups.

In neither model is limited liability (LIMLIAB) a significant predictor for higher rating

in more detail Greene (1997).

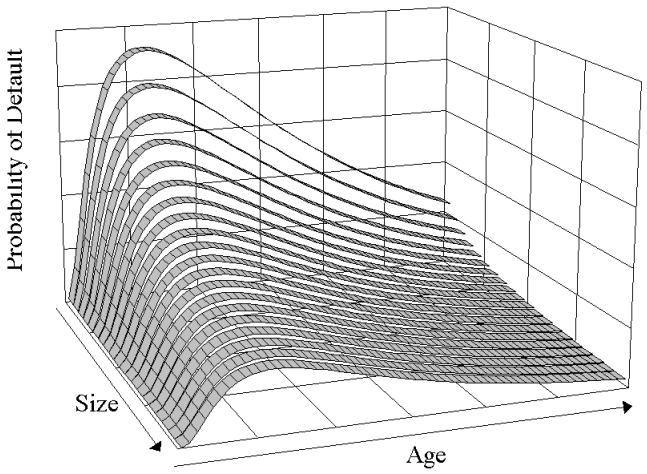
[24] A sampling weight denotes the inverse of the probability that a specific observation is included in the sample due to sample design.

Table 2: Risk factors, rating and probability of default

	Model 1			Model 2		
Variable	**Coeff.**		**Std.Dev.**	**Coeff.**		**Std.Dev.**
LN_TA	-0.1271		0.3367	1.5880		1.0360
LN_TA_2	0.0033		0.0145	-0.0644		0.0409
LN_AGE	-0.0562		0.1524	1.6614	**	0.7765
LN_AGE_2	0.0112		0.0299	-0.3272	**	0.1498
INDEP	0.1553	**	0.0614	0.1439		0.1875
LIMLIAB	0.0763		0.0801	-0.2397		0.2370
EXPORT	0.1746	***	0.0662	0.0569		0.1897
EQU	-1.9340	***	0.2836	-2.2034	***	0.7710
RT	-1.2249	***	0.2665	-3.7875	**	1.7167
CF	-0.2538	***	0.0881	0.2379		0.3372
CLTA	-0.0179		0.0164	0.0271		0.0436
BOARD	-0.2392	*	0.1292	-0.2984		0.5454
HB	-0.1604	***	0.0604	-0.3832	**	0.1746
Y1993	0.2047	**	0.0848	0.8536	**	0.3396
Y1994	0.2943	***	0.0925	0.5910	*	0.3388
Y1995	0.3281	***	0.0901	0.6086	*	0.3397
Y1996	0.3854	***	0.0955	0.5488		0.3411
Y1997	0.8448	***	0.1564	1.3132	**	0.5225
Y1998	0.5940	***	0.1783	2.5328		1.6272
MANUF	-0.1160		0.0759	-0.3068		0.2509
CONSTR	-0.3730	***	0.1361	-0.9861	*	0.5157
SERV	-0.0469		0.0920	0.1808		0.2513
OTHER	-0.1602	**	0.0801	-0.4534		0.3327
B2	-0.1808		0.1242	–		–
B3	0.2368	**	0.1156	–		–
B4	0.2325	**	0.1160	–		–
B5	0.0597		0.1142	–		–
B6	0.2904	**	0.1384	–		–
CONST/Threshold 1	2.0950		1.9908	-12.6011	*	6.6230
Threshold 2	1.4320	***	0.1557	–		–
Variance function						
Variable	**Coeff.**		**Std.Dev.**	**Coeff.**		**Std.Dev.**
B2	-0.2175		0.1347	–		–
B3	-0.9133	***	0.1370	–		–
B4	-0.6581	***	0.1405	–		–
B5	-0.6586	***	0.1425	–		–
B6	-0.1630		0.1469	–		–

Significant at the * 1 percent level / ** 5 percent level / *** 10 percent level.

Figure 2: Age and size effects.



This figure illustrates the age and size effects ignoring the scaling effects of other risk factors. The age runs from 1 to 60 years, the size from 0.1 to 1 million Deutsche Mark total assets. The probability of default increases by steps of 0.05 percentage points.

categories or a higher probability of default, respectively. A possible explanation might be that the the risk–increasing incentive of limited liability is already considered at the stage of contract design. For the medium sized firms in our sample, it is common practice by banks in Germany to remove the limited liability constraint by securing additional private collateral in the credit contract.

Firms with a high degree of export earnings have significantly higher ratings than firms with a low degree or even no export activities in model 1. However, there is no significant effect on the probability of default estimated in model 2. Unfortunately we do not know the main country of the export activities, but the differences in the two estimated models would suggest that country risks are probably overweighted in the banks' rating systems. (If a lot of exports went to the US, for instance, our sample period would coincide with crises in European economies and an economic boom across the Atlantic)

The equity ratio (EQU) and the return on total assets (RT) are important factors in the banks' rating systems. They are highly significant in model 1 and model 2 further corroborates this result. The sign of the effect is in line with the original hypothesis. The higher these ratios, the lower the probability of default. The results concerning dynamic cash flow (CF) and coverage ratio (CLTA) are not as clear as the results with respect to EQU and RT. CF shows a significant negative effect on the rating decision (model 1), but is not significant in the direct estimation of the probability of default (model 2). CLTA is not significantly connected with the dependent variable in neither model. This result would suggest that in a broad statistical analysis detailed differences in the construction of balance sheet ratios are of no particular importance. This is clearly at odds with the overwhelming importance placed on detailed balance sheet analyses for particular cases.

Table 3: Wald tests of joint significance

	Model 1			Model 2		
Variables	**Value**		**dof**	**Value**		**dof**
Probability of default						
Size	2.2302		2	2.6264		2
Age	0.1405		2	4.7785	*	2
Industry	32.8242	***	6	10.4484		6
Branches	9.1000	*	4	9.4408	*	4
Banks	22.6449	***	5	–		–
Variance						
Banks	71.9591	***	5	–		–

Significant at the * 1 percent level / ** 5 percent level / *** 10 percent level.

Table 4: Goodness of fit

	Model 1	**Model 2**
Obs.	1088	879
Pseudo-R2	0.1139	0.2222
Log Likel.	-767.97	-149.66
Restr. Log Likel.[25]	-866.70	-192.41

Whether the lending bank has a seat on the firm's board (BOARD) or an existing a housebank relationship (HB) are both linked with a more favorable rating categorization. The result concerning a seat on the firm's board is not supported by model 2, whereas the result concerning the housebank relationship could also be found in model 2. There are some possible interpretations for these findings. The first concerns a possible risk premium, which firms without a close relationship must pay in form of a higher rating classification. This premium would result from larger information asymmetries between the parties to the credit contract not connected by means of obtaining additional information (seat, housebank) about the borrower and leads to lower rating categorizations for firms in a close relationship with the bank. Conversely, close relationships may lead to a possible loss of objectivity, especially in case of the lender's board membership. Results from financial agency–theory may also be used to explain model 1's findings (Jensen and Meckling 1976). This theory is concerned with asymmetric information and conflict of interest between a firm's management and its equity and bond–holders, respectively. Board membership of a bank may lead to an overall firm policy favoring the interests of fixed claimants (bond holders, loan holders) over those of residual claimants (equity holders), resulting in better credit ratings for these firms.

The dummies Y1993 to Y1998 reflect the prevailing trend in leading German economic indicators during this time period. The effects in relation to the year 1992 are significant in both models. Overall economic effects seem to be reflected in the banks' ratings in an appropriate and adequate way. Likewise, industry effects (MANUF, CONSTR, SERV,

Table 5: Rating and the probability of default

Variable	Coeff.		Std.Dev.	Marginal Effect
Probability function				
R3	0.6330	**	0.2619	0.0728
R4	1.7618	***	0.3819	0.2026
R5	2.6921	***	0.5185	0.3096
R6	3.9601	***	0.6368	0.4554
B2	1.9121	***	0.2617	0.1886
B3	0.8859	***	0.2269	0.0237
B4	-0.0148		0.3743	0.0332
B5	0.6860	***	0.2400	0.1176
B6	1.8916	***	0.3002	0.2482
Const	-3.2070	***	0.4822	
Variance function				
B2	-0.1771		0.2024	
B3	-0.4419	**	0.2229	
B4	0.1972		0.2548	
B5	0.2187		0.2215	
B6	0.1733		0.2025	
Wald test of joint significance				
	Value		dof	
Ratings (probability function)	45.44	***	4	
Banks (probability function)	54.63	***	5	
Banks (variance function)	15.38	***	5	
Goodness of fit				
Obs.	1143			
Pseudo-R2	0.3822			
Log Likelihood	-409.96			
Restr. Log Likel.	-663.56			

OTHER in relation to the machinery) are significant in both models. Observe that the construction sector has received better ratings on average during the observation period relative to machinery. This result is also supported by model 2. German reunification with its boost to construction activities in former East Germany is the most likely explanation for this finding. Results for the manufacturing industry, the service sector and other industries differ more or less between the two models (in relation to the machinery sector). This supports the general fact that future predictions on specific market developments are notoriously difficult.

Concerning question 1 we find some of the required risk factors to have statistical power in model 1, for example EQU and RT, for others like CLTA or LN_SIZE and LN_AGE this is not the case, however. In the estimated relation between the potential risk factors and the probability of default which was the central theme of question 2, we also find that not all risk factors have statistical and discriminatory power. But in relation to model 1, some differences indicate a possibility for improvements of the existing ratings. With regard

to question 3 some possible explanations for the differences between the two models were offered. Nevertheless the differences stress the fact that inherent conflicts appear to exist between internal credit ratings actually used (model 1) and the more direct measure of default probability (model 2).

With regard to question 1, we found that the different sources of the rating information (B2 to B6 with B1 as reference) affect the rating classification considerably. The coefficients in table 2 indicate differences in the level of the classification. This demonstrates that the rating for a specific firm – holding all other variables constant – was higher in bank 3 compared to bank 1. The same applies for bank 4 and bank 6 compared to the reference bank 1. Calculating the marginal effect indicates that the probability to get for example a rating 5 or 6 is between six and seven percentage points larger for clients of bank 3, 4 or 6 compared to bank 1. The results therefore suggest considerable differences in the banks' respective rating systems.

Model 2 has controlled for heteroskedasticity of the disturbance terms resulting from the different sources of the ratings. The variance function in table 2 shows that the errors of the estimated rating function and the observed rating decision differ systematically and significantly between the banks. Bank 2, bank 3 and bank 4 could be reflected by the estimated rating function in a more accurate way than bank 1. This result is also an indicator for remarkable differences between the respective rating systems.

Table 5 shows that the ratings predict the default probability. In relation to the rating categories 1 or 2, all other ratings indicate a significantly higher probability of default. If one uses the estimation results to predict the probability of default, the results are the following. Taking bank 1 as a starting point, rating 1,2 is related to a default probability of 0.07 percent, rating 3 to 0.50 percent, rating 4 to 7.42 percent, rating 5 to 30.33 percent and rating 6 to 77.43 percent. The probabilities of default per rating class of other banks are higher in relation to bank 1.

R6 with a coefficient of 3.9601 indicates that a rating of 6 is – ignoring the scaling of the bank–relevant bank dummy – almost equal to the immediate occurrence of loan repayment problems.[26] It may be argued that causality is often reversed in the case of a decision for rating 6. A firm will be placed in this category because of the actual occurrence of a default event, rather than the expectation of one.

6 Summary and Conclusion

This paper used a unique data set from credit files of six leading German banks to provide some empirical insights into their rating systems used to classify borrowers in their lending business. Background is the early draft of the New Basle Capital Accord, which allows banks to use their internal rating systems to compute their minimum capital requirements. On the basis of the specified minimum requirements which the internal rating systems have to meet, the relations between potential risk factors, rating decisions and the default probabilities were analyzed to answer the question whether German banks are ready for the internal ratings–based approach.

[26] A dummy variable with a value of more than 3 in a probit model caused irrelevance of all other variables.

We use statistical techniques for qualitative dependent variables and control for heteroskedasticity and sample selection to analyze structural relations between risk factors, ratings and (broadly defined) distress probabilities.

Concerning the intended switch from an external to an internal ratings based approach, the most important result obtained is clearly that banks' respective internal rating systems are not comparable across institutions. This proved true despite the fact that an effort was made in this work to harmonize their information content.

Furthermore, there were marked differences between credit rating–determining and default probability determining factors respectively. Whereas firm age exerted an important influence on the default–probability, this was not reflected in the credit rating. On the other hand, there was a systematic variation in the ratings with respect to being part of a group or export exposure, whereas these variables had no significant effect on the default probability. The same holds for the banks membership in the firm's board. This suggests that there is scope for improvement within the banks' rating systems concerning the variables used to estimate default probabilities.

The Basle accord provides for default probabilities to be assigned to individual banks' rating categories determined from the respective banks' own credit rating systems data. Minimum capital requirements are then determined form these default probabilities. The study showed that this default probability for individual classes differed markedly from bank to bank. Though not explored in the present paper, one may safely assume that the same is true for the bandwidths of probabilities within a given rating–class. If a potential borrower's probability of being assigned to a certain risk category with its accompanying effects on minimal capital requirements for the lending bank differed indeed markedly across banks, adverse consequences for inter–bank competition are likely to occur. This would be particularly true if banks with less–developed ratings systems used them to "optimize" capital requirements. Regulatory bodies are therefore well–advised to press for some harmonization of the internal ratings systems before they can supersede the external based approach. With these results in mind, retaining some control of the other risk–influencing factors of the advanced approach also appears to be a good idea at the current stage from the regulator's perspective.

Returning to our original question of German banks' readiness for the IRB, the results of the present study suggest that the answer is clearly not affirmative at this stage. There is still "homework" to be done. The main tasks consist of both, harmonization between and improvements within banks' internal credit rating systems. The same holds true for the draft accord as well, however, in particular with respect to an objective definition of "credit default" or guidelines on the usage of qualitative/subjective information in a bank's rating system.

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