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Subordinated Debt and Prompt Corrective Regulatory Action

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Abstract

Several recent studies have recommended greater reliance on subordinated debt as a tool to discipline bank risk taking. Some of these proposals recommend using subordinated debt yield spreads as additional triggers for supervisory discipline under prompt corrective action (PCA); action that is currently prompted by capital adequacy measures. This paper provides a theoretical model describing how use of a second market-measure of bank risk, in addition to the supervisors own internalized information, could improve bank discipline. We then empirically evaluate the implications of the model. The evidence suggests that subordinated debt spreads dominate the current capital measures used to trigger PCA and consideration should be given to using spreads to complement supervisory discipline. The evidence also suggests that spreads over corporate bonds may be preferred to using spreads over U.S. Treasuries.

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Subordinated Debt and Prompt Corrective Regulatory Action

1. Introduction and overview

Prompt corrective action is based on a simple mandate directed toward bank supervisors: "resolve the problems of insured depository institutions at the least possible long-term cost to the deposit insurance fund."[1] The central provisions of prompt corrective action (PCA) aim to provide a series of interventions as a bank's financial condition deteriorates. Moreover, rather than relying solely on supervisory judgment about a troubled bank's financial condition, PCA focuses on quantifiable measures of a bank's financial condition. In particular, supervisory intervention is currently triggered by bank capital adequacy ratios.

Although quantifiable measures have a variety of advantages, probably the most important advantage in the context of PCA is that their use reduces the scope for supervisors to exercise forbearance. The measure used, however, needs to be closely associated with the financial condition of the bank if it is to effectively achieve this purpose. A limitation of focusing almost exclusively on capital adequacy ratios is that banks and supervisors have substantial influence over the calculation of the numerator (capital) and denominator (a proxy for risk) of these ratios. The Basel Bank Supervisors Committee is currently trying to address problems in the calculation of the denominator, [see BIS (2001)]. Yet the more serious problem lies with the measurement of capital. Whether capital is measured using historical cost accounting (as is currently the case) or economic value accounting, a bank's capital will reflect declines only if the bank

[1] Section 131 of FDICIA, titled "Prompt Regulatory Action," creates a new Section 38 of the Federal Deposit Insurance Act.

voluntarily recognizes the losses or the supervisors force recognition. Given that banks usually resist recognition of losses that would result in their being undercapitalized under PCA, responsibility for accurate capital measurement rests with the supervisors. This is to say, if the supervisors want to exercise forbearance, all they need do is acquiesce to a bank's refusal to recognize losses. Prominent examples of such acquiescence by supervisors include recognition of losses at U.S. banks due to loans to less-developed-countries (mostly in Latin America) in the 1980s and recognition of domestic loan losses by Japanese regulators throughout the later 1990s.

An alternative to exclusive reliance on capital adequacy ratios would be to use some market-based risk measure as a trigger for supervisory action. Examples of such measures would include the spread of subordinated debt obligations over comparable maturity Treasury obligations as proposed by Evanoff and Wall (2000a) and probabilities of default calculated using stock returns, such as is done by KMV [see Gunther, Levonian and Moore (2001)].[2] The advantage of using a market-based risk measure is that market participants have a strong incentive to base their valuations on the expected payouts for their claim, whether or not a particular price is the one desired by banks and their regulators. The disadvantage of using a market-based risk measure is that the prices may incorporate more than the credit risk of the issuer. For example, the price of a bank's debt depends in part on factors such as the term structure of interest rates and the liquidity of the debt obligation.

[2] For discussions of the benefits of introducing a mandatory subordinated debt program for large commercial banks see Evanoff and Wall (2000a,b,c), Kwast, et al. (1999), and Flannery (2001). While subordinated debt proposals are frequently associated with U.S. banking markets, there is evidence from European markets suggesting similar potential benefits: see Sironi (2001) and Benink and Wihlborg (2002).

The fact that the pricing of market obligations depends on more than the credit risk of the obligation is one of the primary arguments raised against plans to use market-based risk measures. Supervisors, it is argued, should not be forced to discipline a bank based on a market-based measure when they know that the bank is in good financial condition.[3]

This paper addresses the criticism of using market-based risk measures in two ways. First, it provides a simple model to illustrate the underlying wisdom of PCA, that the use of a quantitative risk measure may produce better outcomes even if the quantitative risk measure is on average less accurate than supervisory evaluations. The model considers two cases. The first is one where the supervisor knows the true condition of some banks, but not others. In this case the quantitative risk measure may improve the evaluation of banks about which the supervisor is uncertain. In the second case, the supervisor knows the condition of all banks with certainty and the condition of the bank is measured with error by the quantitative measure. However, in this situation the supervisor exercises forbearance toward banks that should be disciplined with positive probability. The use of a quantitative measure may improve outcomes in this second case by reducing the probability of forbearance, even though it may result in the disciplining of a healthy bank.

The second part of the paper provides empirical evidence on the potential use of subordinated debt yield spreads as a trigger for PCA. This paper extends Evanoff and Wall (2001) which provided evidence that subordinated debt spreads over both Treasury and corporate bond indices are better predictors of supervisory ratings than are the risk-

[3] Evanoff and Wall (2002, p. 1007) discuss alternative means to incorporate subordinated debt yields in PCA which some may find less Draconian and more palpable.

based capital adequacy ratios. Evanoff and Wall (2002) focus on banks that have high subordinated debt spreads over Baa yields, but are rated satisfactory by the bank supervisors. That analysis finds that almost all of the banks with high spreads have some indication that they are indeed higher risk. In a few cases, the supervisors appeared to be substituting frequency of exams for reductions in CAMEL or BOPEC ratings. Other measures of risk considered that indicate that the high spread banks were indeed higher risk include regulatory early warning scores, market-to-book ratios, credit agency ratings and recent supervisory ratings.

This paper extends Evanoff and Wall (2002) to examine banks with high subordinated debt spreads over U.S. Treasury rates. The focus is on spreads over Treasuries for a couple of reasons. First, spreads over Treasuries may provide more accurate, albeit more procyclical, measures of banks' risk than spreads over Baa debt. The average spread of Baa securities over Treasury securities increases as credit defaults increase, providing an automatic relaxation of any standard that uses subordinated debt spreads over a Baa index. The use of a Treasury index may provide a more consistent test through time. Second, Evanoff and Wall (2002) used spreads over Baa in part for a practical reason that may no longer be relevant. At the time of their analysis, the stock of publicly traded Treasury securities was forecast to disappear due to federal government surpluses. Budgetary developments since the terrorist incidents of September 11, 2001 suggest that the stock of publicly traded Treasury securities may remain substantial. Evanoff and Wall (2002) discuss the theoretical advantages and disadvantages of the

alternative spreads.[4] The empirical analysis in this paper may highlight the actual differences during the sample period.

The paper is organized as follows. The next section contains the theoretical model describing how use of a second 'market measure' of bank risk to initiate PCA may be beneficial. The third section discusses the data and empirical methodology used to test the implications of the theory. The fourth presents the results and the final section summarizes and provides concluding remarks.

2. Disciplining banks with two risk signals

This section develops a model of optimal bank discipline when two risk signals are available. The first subsection lays out the assumptions of the model. The second analyzes optimal solutions under the assumption that supervisors act in a socially optimal manner. The third subsection analyzes the solutions under the assumption that supervisors sometimes exercise forbearance on weak banks even though the social welfare would be enhanced if the banks were disciplined. The fourth section discusses the implications of the results.

2.1 Model assumptions

The objective of the social planner is to establish rules that minimize the cost of errors in the disciplining of banks. Banks are assumed to be of two quality types $Q \in \{H, L\}$. Type L banks are low quality and should be disciplined by the regulators. Type H banks are high quality and should not be disciplined. Given that the null hypothesis is that a bank is solvent, then disciplining a type H bank is a type-1 error that generates total

[4] One of the major differences being the extent to which the different spreads 'bind' over the business cycle.

social costs of *T1*. Conversely, failure to discipline a type *L* bank is a type-2 error that generates total social costs of *T2*.

Bank types are not directly observable but bank examiners receive a signal of each bank's quality at the end of their examination. The signal to the examiners, *R*, may take one of three forms: $R \in \{A, B, C\}$. If the examiner receives signals *A* or *C* then the bank's type is revealed with certainty: signal *A* signifies a type *H* bank and signal *C* signifies a type *L* bank. If the signal to the examiner is *B*, however, then the examiner knows only that the bank is type *H* with probability *q* and type *L* with probability (1-*q*).

A second[5], independent signal of a bank's quality, *IS*, may also be observed: $\infty<IS<\infty$.[6] For example, bank capital adequacy ratios are currently used as an independent signal to prompt PCA. For this signal, the probability that a bank is of high quality is $p(H|IS)$ and the probability that it is of low quality is $(1-p(H|IS))$. The probability that a bank is of high quality is an increasing function of *IS:*

$$p'(H|IS) > 0.$$

This general formulation allows, but does not require that the independent signal be perfectly correlated with a bank's condition.

2.2 Model solution without agency problems

If there are no agency problems, the examiner always uses his signal optimally, and no other signal exists then the decision rule is straightforward. The examiner: (1) never disciplines banks when the signal is *A*, (2) always disciplines banks when the signal

[5] This second signal could be any one of a number of signals including those that are the focus of this study: a capital adequacy ratio and the yield on a bank's subordinated debt. However, the signal could take a variety of other forms including the cost of "perks" provided to the CEO if these signals contained information about the bank's quality.

is *C*, and (3) and disciplines banks when the signal is *B* only if the expected cost of incorrectly disciplining type *H* banks that are rated *B* is less than the cost of incorrectly failing to discipline type *L* banks:

$qT1 < (1\text{-}q)T2$.

If an alternative signal, *IS,* is available then its use may reduce the social costs of incorrectly disciplining banks. One way of incorporating *IS* into the discipline process, along the lines of PCA, would be to establish a single trigger score for disciplining all banks, *t*. That is, all banks with *IS* values less than *t* would be disciplined. In addition, any bank with an *IS* value greater than *t,* but that received an examination rating of *C* would also be disciplined. In this case the social planner would solve for the value of *t* that minimizes the costs of disciplining all banks.

$$\min_t SC = \int_{-\infty}^{t} T1\,p(H \mid IS, R = A)dIS + \int_{-\infty}^{t} T1\,p(H \mid IS, R = B)dIS + \int_{t}^{\infty} T2(1 - p(H \mid IS, R = B))dIS \qquad (1)$$

The use of a single trigger score for all banks would result in the cost of Type-1 errors arising from disciplining some banks that received an examination rating *R=A*. There would also be costs associated with the classification errors of some high and low quality banks that receive an examination rating of *B*. There would not be errors associated with failing to discipline banks that received an examination rating of *C* because all of these banks would be disciplined.

The strict adherence to a single trigger point with the *IS* signal for all banks is inefficient in the absence of agency costs. The examiners know with certainty that type *A*

[6] In the model presented we incorporate a signal that is assumed to be increasing in the quality of the bank, e.g., bank capital ratios. If the quality of the bank is *decreasing* as the signal increases, as with

banks should not be disciplined and type *C* banks should be disciplined. Thus, the independent signal could be applied only to those banks receiving an examination rating of *B*, where the banks may be of high or low quality. In this case, the social planner first finds the optimal trigger point:

$$\min_t SC = \int_{-\infty}^{t} T1\,p(H \mid IS, R = B)dIS + \int_{t}^{\infty} T2(1 - p(H \mid IS, R = B))dIS \qquad (2)$$

The social planner then selects the strategy with the lowest cost: (1) disciplining all type *B* banks, (2) disciplining none of the type *B* banks, and (3) disciplining only those banks with examination ratings of *B* and an $IS > t$.

2.3 Model solution with agency problems

Although the application of a single trigger point to all banks may be suboptimal in the absence of agency problems, PCA was explicitly developed to address agency problems; see Benston, et al. (1986). Thus, a more thorough analysis of PCA requires an environment in which supervisors do not always impose discipline on banks even when examination results indicate that discipline is appropriate. In order to focus on this agency problem, in this section we assume that the examination signal observed by the supervisor contains no error, that is all banks receive an examination rating of *A* or *C*. Furthermore, assume that the examiners do not always forbear on banks with an examination rating of *C*, but rather exercise forbearance (or leniency) with a probability of *l* where $0 < l \leq 1$. Moreover, supervisors know that if they rate a bank *C* and fail to discipline the bank then Congress may learn of the forbearance and impose a penalty on

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subordinated debt spreads, the model would need to be adjusted accordingly.

them. Thus, as part of the decision to exercise forbearance, supervisors will also claim that the examination of the bank returned a signal of *A*.

For a given probability of forbearance, *l*, the social planner's problem is to pick a PCA trigger rate that minimizes the following social costs:

$$\min_t SC = \int_{-\infty}^{t} T1\,p(H \mid IS, R = A)dIS + \int_{t}^{\infty} T2(l)(1 - p(H \mid IS, R = C))dIS \qquad (3)$$

The first order condition for a solution of equation (3) is:

$$\partial SC/\partial t = T1\,p\,(H \mid t,\ R = A) + T2l - T2(l)\,p(H \mid t,\ R = C) = 0\,. \qquad (4)$$

Let the value of *t* that solves equation (4) be *t**. Then the effect of an increase in the proportion of *C* rated banks that receive forbearance, *l*, on *t** is:

$$\frac{\partial t}{\partial l} \mid_{F.O.C.=0} = -\left[T2 - T2\,p(H \mid t, R = C)\right] \Big/ \left[T1\,p'(H \mid t, R = A) - T2lp'(H \mid t, R = C)\right] > 0 \qquad (5)$$

That is, an increase in the proportion of banks receiving forbearance leads to a decrease in *t**. Given that *t* is directly related to bank quality, this suggests that an increase in forbearance leads to more banks being disciplined.

2.4 Implications

The results in the case with no agency costs have implications for the use of an independent signal. First, a single trigger point for all banks is inefficient. Thus, absent agency costs, the current structure of PCA with a set of trigger points that applies to all banks is inefficient if examiners sole goal is to minimize social costs from incorrectly disciplining banks. Second, the use of an independent signal may improve social welfare even if it is not always very accurate. The signal need only be better than imposing a uniform discipline policy for all banks with examination ratings of *B* in order to improve

social welfare. The proportion of banks with examination ratings of *A* and *C* that would be misclassified by the independent signal is irrelevant if the independent signal is only applied to banks with examination ratings of *B*.

The results in the case allowing for agency costs also have important implications for the situation where agency costs are relevant. First, the independent signal need not be more accurate than the signal observed by examiners. The signal to the examiners in the model with agency costs does not contain any error, but the use of an independent signal may, depending on parameter values, nevertheless be preferred from a societal perspective because supervisors do not always discipline banks with low examination signals. Second, an increase in the rate of forbearance will lead to a lower trigger point, t^*, for the independent signal. Thus, if the trigger point for PCA using the independent signal is t^* then *ex post* evaluations of the accuracy of the PCA measure will be biased down if the probability of forbearance is greater than zero. The optimal trigger point is set with the intention that supervisors will sometimes act before the trigger forces supervisory action.

A general implication for the empirical analysis is that we should pay special attention to cases where the independent signal says the bank is high risk, but the examination signal says it is low risk—this is where both the costs and benefits of the independent signal arise. If the independent signal is incorrect then using it generates costs, if the independent signal is correct then using it generates benefits.

3. Measuring bank risk

The empirical analysis below focuses on the cases where subordinated debt yield spreads are high but supervisory ratings are satisfactory. However, to motivate the

potential use of subordinated debt yield spreads as a PCA trigger, we contrast the relative accuracy of alternative capital ratios and subordinated debt spreads in predicting bank condition. We measure bank condition as subsequent CAMEL or BOPEC ratings.[7] Evanoff and Wall (2001) found that subordinated debt spreads outperformed most of the capital measures, including the measure currently used to trigger PCA, in predicting bank condition. Capital measures were shown to add very little predictive power once the debt spread was accounted for.[8] Below we summarize those findings.

For the current analysis we introduce results from the estimation of alternative single-variable logit models in Evanoff and Wall (2001) and use them as a starting point to more fully evaluate observations where predictions from debt markets do not coincide with supervisory ratings.[9] As emphasized in our theory section, these are the very observations where adding a second signal to the PCA process could have the most impact.

3.1 Data

We use the data developed in Evanoff and Wall (2001). It includes a sample of bank subordinated debt yields between 1985 and 1999 that satisfy two criteria: (1) the issuer must be among the 100 largest domestic banking organizations in the United

[7]These are measures of the composite financial condition of the bank or bank holding company, respectively, as summarized by the federal banking agencies.

[8]It could be argued that one limitation of this analysis is the possibility that capital ratios, debt spreads and supervisory ratings may not be independent. Investors in subordinated debt certainly care about supervisor's evaluations and supervisors have demonstrated a strong interest in capital ratios. Supervisors may also care about subordinated debt spreads. Evanoff and Wall (2001) attempted to minimize the potential for supervisory evaluations to influence capital ratios and yield spreads by using the risk measures to predict supervisory ratings in the *following* quarter. Whether spreads influenced examiners is impossible to determine without additional information; however, discussions with examiners suggest that supervisors were not placing much weight on subordinated debt spreads in the late 1990s. However, since we are analyzing observations where the two measures *differ,* whether the two measures are independent is less important.

States, and (2) the bond must be listed on Bloomberg with quarterly yield data. If sufficient trading occurs in a bond, then Bloomberg reports volume-weighted average transaction prices. If trading is not sufficient, then matrix-generated prices based on price quotes from informed market traders are reported. Prices are weighted averages based on a minimum of two price sources and they must be within an "acceptable" tight range.[10]

Much of the analysis in Evanoff and Wall (2002) uses subordinated debt yield spreads over maturity matched Baa corporate bonds. The current analysis evaluates spreads over maturity matched Treasury security yields. Treasury yields are obtained from the Board of Governors of the Federal Reserve System's web site and the spread over Treasuries is calculated as the difference between the subordinated debt yield and the calculated yield on a comparable maturity Treasury security.[11]

We also obtained confidential supervisory ratings from the Federal Reserve Supervision Department database. The ratings are the composite CAMEL(S) rating for banks and the composite BOPEC rating for bank holding companies. About 70% of the observations are at the bank holding company level. Capital adequacy ratios are calculated using data from the Reports of Condition and Income filed by banks (Call Reports) and bank holding companies (FR Y-9C) with their respective federal supervisor.

We examine a subsample of 452 observations from the data in Evanoff and Wall (2001) that contains complete information on the bond spreads over Treasuries. Within this subsample there are 13 banks with a supervisory rating of 3 or lower.

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[9]Readers interested in a more thorough critical analysis of the use of capital ratios for triggering PCA are referred to Tables 1-4 of Evanoff and Wall (2001).

[10] For a more detailed description of the data see Evanoff and Wall (2001, 2002).

[11] Comparable maturity Treasury obligations are obtained via linear interpolations of the term structure across 3 month, 6 month, 1 year, 2 year, 3 year, 5 year, 7 year, 10 year and 30 year securities.

3.2 Results

The results of estimating logit models to predict supervisory examination ratings are presented in Table 1 and are from Evanoff and Wall (2001). They indicate that subordinated debt spreads over Treasuries (*Sub-debt spread over Treasuries*) provide greater predictive power than the current PCA capital adequacy standard (*PCA capital adequacy status*). Although the "percentage correct" is relatively high for the *PCA capital adequacy status*, the high level of "tied" observations suggests the model is not very confident of its assignment of individual observations and the low percentage of correct 3-4 classifications suggests the model is doing very poorly in identifying problem banks. The rather low concordance found using the alternative capital measures raise concerns about their usefulness to forecast future problem banks. Therefore, with one exception, the alternative capital adequacy ratios are generally inferior to the spread measures at predicting supervisory rating; the exception being the *Tier-1 leverage ratio*. Evanoff and Wall (2001), Table 3, present further results from estimating models that include both the debt spreads and capital adequacy measures. Their results indicate that inclusion of the capital measures appear to add little to the explanatory power of the models. The performance of subordinated debt spreads satisfies an important prerequisite for tying PCA to debt market information.

While the spread measures perform better than the current PCA triggers at predicting troubled banks, as discussed below, they still result in a number of misclassifications; i.e., the spread suggests the bank is high-risk while the supervisory rating suggests otherwise. As discussed earlier, these differences are a prerequisite for generating cost and/or benefits from initiating PCA with debt spreads. Additional

analysis is therefore needed to associate the spread and risk measures and to determine the extent of the potential gains from such a program.

4. A more detailed analysis of "misclassifications"

This section discusses the empirical methodology used to analyze the misclassifications resulting from using the debt spreads to predict risk levels as proxied by supervisory ratings. Can we delineate the source of the differences in bank classification between debt spreads and supervisory ratings?[12] In particular, we consider *a priori* reasons for expecting that in certain circumstances the spread may be a poor indicator of bank condition. We also evaluate situations in which subordinated debt spreads may be a better indicator of bank risk than the model projects.

4.1 Misclassifications and liquidity issues

The spread on a bank's subordinated debt over comparable maturity Treasury securities may depend on a variety of factors, perhaps the largest of which is the reduced liquidity of bank issues, see Hancock and Kwast (2001). If this premium is approximately the same for all banks, its presence simply requires an adjustment to the spread used to trigger supervisory action. However, if it varies across banks, some additional adjustment needs to be made. Most subordinated debt proposals recognize that bond issues by smaller banks are likely to have higher liquidity premiums because the issue size is smaller and may attract less attention from bond analysts. Hence, smaller banking organizations are typically excluded from mandatory subordinated debt issuance

[12] Evanoff and Wall (2002) address the issue of whether debt spreads and supervisory ratings are measuring the same risk. The concern is that subordinated debt yields reflect only expected losses to the holders of the debt while the primary concern of supervisors is the probability of failure. Thus, any misclassifications may simply result from measuring different risks.

requirements.[13] As a rough first approximation, we consider any debt issue by a bank not among the largest thirty in that year to be likely to have a relatively high liquidity premium. These banks are then excluded from further analysis.[14]

4.2 Additional factors to consider in evaluating the accuracy of the yield spreads and examination ratings

After accounting for the above mentioned liquidity concerns, the remaining observations will be evaluated to determine when the debt yields identified a problem that was apparently not being reflected in the examination ratings. This part of the empirical analysis is made more complicated by our inability to objectively determine the true condition of the bank. Unfortunately, the problem of not having the true measure of a bank's condition is unavoidable in analyzing an independent signal of bank risk. Thus, we examine a variety of measures while being careful to note any limitations on the conclusions that can be drawn from the results. Our procedure is to use supervisory information and a variety of accounting and financial market measures to identify banks that appear to be financially distressed around the time of the examination although the regulatory rating suggests the bank is low risk.

We use two measures of supervisory concern about the bank. The first is whether the bank has been re-examined within a six-month period. While bank supervisors ordinarily go at least one year between examinations, in some cases in our sample the

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[13] For example, Evanoff and Wall's (2000a) proposal would require only the largest 25 banks to issue subordinated debt. Similarly, most of the discussion in Kwast et al. stresses the debt of the top 50 U.S. banking organizations.

[14] While this partially addresses the liquidity issue there may still be a time dimension to liquidity (e.g., ad hoc events or cyclical effects) that we are not capturing. In earlier work we attempted to account for this by allowing for fixed time effects in the empirical analysis and the results were not appreciably changed. However, this is an important issue that merits future work to develop a more accurate signal of firm condition.

supervisors appeared to be substituting frequent exams for lower CAMEL ratings. Discussions with examiners indicate that this procedure has been followed for some banks at certain times in the past.[15] The second measure of supervisory concern is whether the bank has been or will be rated less than satisfactory within one year of the current rating.

We also consider alternative accounting measures of the condition of the bank. Accounting ratios are accounted for via parameter estimates from econometric forecasting models aimed at identifying problem banks—early warning models. The econometric model approach is more likely to yield an objective risk measure. The models were created to use accounting data to identify potential problem institutions to help guide the use of examination resources.[16] If these models indicate that the banks identified by the yield spreads had a higher probability of failure or were good candidates for a rating downgrade, that result would be consistent with debt yield spreads correctly signaling that the bank is high risk.

We use two early warning models to identify banking organizations that were good candidates for downgrades both at the time of the examination and over several subsequent quarters. The first is that of Gilbert, Meyer, and Vaughan [GMV (2000)]. The model is designed to predict future bank supervisory rating downgrades to less than

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[15] This indicator is not perfect. A follow-up examination may occur for other reasons such as to evaluate the safety and soundness implications of a proposed takeover. However, in most cases in our sample there appears to be confirmation of supervisory concern in the form of repeated re-examinations over the same time period, or signals from one or more of our other indicators. In addition, the fact that the supervisors are substituting examination frequency for lower CAMEL ratings does not necessarily imply that the supervisors are failing to impose adequate discipline. We do not have information on the recommendations made by supervisors to these banks or on what action the supervisors threatened to take if their recommendations were not followed

satisfactory condition (i.e., CAMEL 3, 4 or 5) based on accounting data. It is more flexible than other early warning models commonly used by supervisors in that it emphasizes the potential for deterioration in bank condition rather than bank failure; downgrades being a much more common phenomenon during our sample period. As such, parameter estimates are allowed to vary through time to more accurately account for changing influences on bank condition. Where appropriate, we also augment the results of the GMV model with those of the Federal Reserve's "System to Estimate Examination Ratings," or SEER risk rank model, which is used to predict the probability of bank failure.[17] The GMV ratings are obtained from the authors and the SEER risk rankings are obtained from confidential Federal Reserve supervision files.

Common stock prices may also yield information on the financial condition of banking organizations. As a rather crude proxy for bank condition we consider a market-to-book ratio of less than one as being indicative of the equity market's concern about the financial condition of a bank. An alternative measure would be market-adjusted equity returns. We do not include this measure in our analysis, however, because negative equity returns may be caused merely by a firm's transition from having great earnings prospects to having mild difficulties that should not be sufficient to trigger PCA. Another alternative is the price-to-earnings ratio, but the interpretation of this ratio is less clear when a bank suffers losses. Thus, results consistent with the supervisors exercising forbearance would be: (1) low debt ratings, (2) the equity market measure indicating

[16] Krainer and Lopez (2001) augment these models with information from equity markets and find the additional information to be of value in predicting future regulatory ratings.

[17] For a discussion of the model see Cole and Gunther (1995) and GMV (2000). The SEER model is less flexible in that bank failures have been so rare during the 1990s that the parameter estimates have been frozen throughout the period.

problems before the satisfactory examination rating is assigned, and (3) the equity market measure indicating a problem after the examination rating is assigned. The bond ratings are obtained from *Moody's Banking and Finance Manual, various issues.* Market-to-book ratios are obtained from the *American Banker* for the last business day in each quarter.

5. Empirical results

Based on the model presented in column 5 of Table 1, and employing probability assumptions similar to those employed in Evanoff and Wall (2002), the analysis correctly predicts 288 observations, misclassifies (misses) three high risk institutions and misclassifies (erroneously classifies as high risk) 183 observations. The 183 type-2 errors can be significantly improved upon by raising the spread threshold from an 84 basis point spread to 90 or 100 basis points.[18] However, we base our analysis on the 84 basis point spread to approximately match the cut-off point suggested by the logit estimation results in column 5 of Table 1 and to enable us to compare results using spreads over alternative debt instruments.

The cut-off point of 84 basis points correctly classifies 10 of the 13 banks with CAMEL ratings of 3 or 4. The bulk of the following analysis emphasizes the 183 additional banks (35% of the highly rated banks) classified as problem institutions although the supervisory rating suggested otherwise. As mentioned above, the misclassification may occur for a number of reasons including the possibility that subordinated debt markets simply incorrectly classify low-risk institutions as high-risk. We evaluate this possibility. The first subsection compares the high-spread banks with

the remainder of the sample, the next subsection further analyzes the characteristics of the high-spread banks and the final subsection summarizes the lessons learned from the empirical analysis.

5.1 Contrasting high- and low-spread banks

A comparison of certain characteristics of banks with high spreads versus those with low spreads is found in Table 2. The results presented in the first three rows suggest there is little difference in capital adequacy ratios between the high-and low-spread groups, in either a statistical or economic sense. We also found that there was essentially no difference in an ordinal PCA capital adequacy measure taking on values from 1 to 5 depending on whether the bank is considered Well Capitalized, Adequately Capitalized, Under Capitalized, Significantly Undercapitalized or Critically Undercapitalized, respectively, under the guidelines introduced in the early 1990s. This index is of particular interest since it is the measure currently being used to trigger PCA.

Substantial differences exist, however, across the two subgroups using alternative criteria to measure potential bank problems. To incorporate information from early warning models, two alternative measures based on the GMV (2000) regulatory downgrade model are presented in Table 2. The first, GMV-1, is a measure of the probability of a downgrade based on beginning of year projections. GMV-2 is based on end-of-year data; thus it measures conditions realized during the year and can be considered more of a current-condition measure while the GMV-1 measure is more forward looking. Each measure is indexed to the mean of the non-problem bank subsample.

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[18] The type-2 errors decline to 153 and 97 for a 90 and 100 basis points spread, respectively. One's choice of the appropriate threshold depends on the relative trade off in unnecessarily disciplining problem banks

The GMV-1 measure of bank condition for our high-yield spread subsample is over four times that for the other group, suggesting a substantial difference in the potential for downgrades to less than satisfactory status across the two groups.[19] Results using the GMV-2 measure suggest even greater differences. There are also differences using the regulator's SEER model. Thus, there is some evidence that the "misclassified" observations may be different from satisfactory rated banks.

5.2 Analysis of high spread banks

In this section we further delineate the high spread banks. We first separate the banks with high spreads into three groups: those that we can explain as either being in agreement with supervisory ratings, those that may have significant noise in their yield spread measures, and the remaining banks. This remaining group, the 'unexplained' observations, is then further investigated.

The observations that are easily explained are summarized in Table 3. The 193 observations are first ranked by spread with a ranking of 1 assigned to the highest spread and a ranking of 193 assigned to the lowest spread (but greater than 84 basis points). The observations are then separated by these rankings into eight sets of 25, with the last set including the 17 observations with the smallest spreads (but greater than 84 basis points). This procedure allows an evaluation of the accuracy of the spread measure as yield

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versus failing to discipline troubled institutions (i.e., the relative cost of type-2 and type-1 errors).

[19] This forward-looking measure best serves the intended role of the model: to predict future downgrades. The alternative measure (GMV-2) is included for robustness since the actual date of the examination information may be closer to the end of the year. Individual year subsamples were also analyzed since the period could be divided into particularly tranquil and less-tranquil subperiods. There was still a consistent difference across subsamples. One caveat, however, concerns the population of U.S. banks used to generate the GMV (and SEER discussed later) prediction model. Although it includes larger banks, the sample is dominated by smaller institutions. Thus, our sample of debt-issuing banks would not be a representative sample of banks from which the model parameter estimates were generated.

spreads decline while at the same time providing ample protection for the confidentiality of individual bank examination ratings.

The second column contains the number of observations in each set where the bank is rated less than satisfactory (i.e., a CAMEL or BOPEC rating of 3 or 4). These are the observations where the yield spreads and the supervisors appear to be reaching similar conclusions. For example, among the banks with the largest 25 yield spreads, two banks were rated less than satisfactory by the supervisors.

The third column contains the number of observations with potentially noisy data because the observations came from a smaller bank. For example, eight banks with spreads ranked between 26 and 50 in our sample fall into the category of banks with potentially noisy data. The fourth column contains the unexplained observations where the bank received a satisfactory rating and there is no obvious indication that the spread measure contains unusual noise.

Table 4 provides an analysis of the unexplained misclassifications. Columns 3 through 7 of Table 4 provide information on the extent to which other risk measures suggest the bank was high-risk. A high early warning score is defined as one at least four times the mean value of the GMV-1 model, GMV-2 model or SEER model. In some cases there may be multiple reasons for classifying the bank as potentially high-risk, thus a bank may be included in more than one of the columns. For example, a bank that was re-examined within six months and had a high early warning score would be included in both of those columns. Column 8 gives the number of banks for which, after accounting or these additional factors, there is still no indication of higher risk.

The results in Table 4 suggest that a significant proportion of the unexplained observations with high yield spreads had one or more indicators that the bank was actually high risk. Combined with the banks that were assigned less-than-satisfactory regulatory ratings, this suggests that many of the banks that subordinated debt markets suggested were high-risk, were also banks about which the supervisors or market had some concerns.

After accounting for these indicators of above-average risk, we are left with thirty-nine bank observations with no obvious indication of problems; from an original 183 misclassifications. While a number of these would have been eliminated if we had adjusted our threshold criteria to 90 or 100 basis points, whether one chooses to do that depends on how one weighs the costs of disciplining a sound bank versus the costs of failing to discipline a weak bank. However, we still would have been left with some banks misclassified as risky banks as a result of their relatively high spreads.

Comparisons of these results with those found using a spread over Baa rated debt [Evanoff and Wall (2002)] indicates that use of the spread over Treasuries results in more misclassifications as type-2 errors. In the analysis using spreads over Baa yields, 21% of the unexplained observations (after accounting for thin market trading and data concerns) showed no indication of having higher risk characteristics. In the current analysis (after accounting for thin market trading) 40% of the observations showed no indication of having higher risk characteristics---i.e., contrasting columns 2 and 8 of Table 4. Additionally, the unexplained observations using the Baa spreads were generally bunched near the threshold; that is these observations had relatively low spreads in the group of misclassified observations. In the current analysis, the misclassifications are more evenly

spread across various spread-groupings (rows in Table 4) instead of being bunched at or near the threshold. Thus, the spread over Treasuries does not appear to perform as well as the spread over Baa rated corporate debt in identifying high-risk banks.

One important difference between the sample used in this study and that in Evanoff and Wall (2002) is that the current study incorporates a longer sample period. The earlier study was limited to the 1990 to mid-1998 period due to limitations of their corporate bond yield spread data. The longer sample period used in this study incorporates the collapse and restructuring of Long-Term Capital Management (LTCM) in September 1998. An important part of LTCM's strategy was to earn profits by supplying liquidity to a number of relatively illiquid markets. LTCM's positions were unwound and its operations were ultimately shut down after September 1998, resulting in a reduction in liquidity and an increase in liquidity premiums in a number of markets [see President's Working Group (1999)]. If the collapse and restructuring of LTCM caused an overall increase in liquidity premiums in corporate bond markets, the spread of bank subordinated debt issues over Treasury securities during this period would also have increased. Such an increase would be mistaken as an increase in credit risk premiums for the post-LTCM sample of bank subordinated debt in Tables 3 and 4.

5.3 Post Long-Term Capital Management

This section explores the possible impact of LTCM on the information content of subordinated debt yield spreads by dropping those observations from September 1998 to the end of the sample period. If the collapse and restructuring of LTCM increased liquidity premiums then deleting observations after its collapse should reduce the proportion of unexplained observations for which there are no obvious indicators of risk.

Deleting all of the observations from September 1998 to the end of the sample reduces the number of high-spread observations by 75 to 118. The results from the pre-LTCM period are presented in Tables 5 and 6 in a format similar to that of the entire sample in Tables 3 and 4.

In contrast to the results for the entire sample, most of the observations in Table 5 with less than satisfactory supervisory ratings are in the group of banks with the highest spreads. Also, the number with less than satisfactory ratings declines uniformly as the spread increases.

The number of observations with no indicator of problems in Table 6 (row 8) is less than the number with no indicator in Table 4 for each of the rows. The number with no indication of problems in the group of banks with the highest spreads drops from 3 to 1, the number in the group ranked from 26-50 drops from 7 to 5, and the remaining declines are even more dramatic. The fall also occurs as a proportion of the unexplained observations (contrasting columns 2 and 8 of Tables 4 and 6). The proportion of unexplained observations with no indicator of risk drops to 23% (14/62), which is essentially the same as Evanoff and Wall (2002) found using Baa spreads. However, the results in Table 6 differ from those obtained using spreads over Baa debt in that over one-third of the observations with no indicator or risk are in a category of banks with relatively high spreads (see the row for banks with the 26-50 highest spreads in Table 6*).* Taking a closer look at observations in this row, however, a majority of them were obtained from a single quarter in 1987. This suggests that closer analysis of these observations may yield additional insight into potential issues surrounding market

disruptions that need to be considered when using subordinated debt yield spreads; particularly spreads over Treasuries.

While the collapse and restructuring of LTCM appears to have influenced the liquidity premiums on corporate bonds, its collapse and restructuring may also have influenced the credit risk spreads on these bonds. The collapse may have increased credit risk premiums to the major banks that were LTCM's creditors and counterparties in over-the-counter (OTC) derivative transactions due to the risk that LTCM would not be able to honor these debts. The collapse may also have threatened the value of the trading and investment portfolios of banks that held positions similar to LTCM if portfolios had to be liquidated at distressed prices. While such a credit risk increase in spreads is potentially important for some banks, it appears not to be very important for our sample. The banks that were most exposed to LTCM were the money center banks that had credit exposure to LTCM and may also have had similar trading positions. Given that LTCM was restructured without major losses to creditors and its positions unwound in an orderly manner, its creditors suffered, at most, minor losses. If some bank's subordinated debt yields experienced large increases in credit risk premiums due to LTCM, the jump in yields should have happened to the largest banks in the September or possibly December 1998 periods. Yet, looking at our sample during this period, there is only one large bank that could have experienced such an increase in credit spreads.[20]

A second way in which LTCM may have influenced credit spreads is by reinforcing market perceptions that some financial firms are too-big-to-fail. In LTCM's

[20] Recall that in order for a subordinated debt issue to be included in our sample, the issuer must have received a CAMEL(S) or BOPEC rating from its federal supervisor in the following calendar quarter. Thus, many potentially relevant debt issues are not included because the bond issuer did not receive a rating during the quarter.

case, the Federal Reserve Bank of New York organized the meetings to restructure LTCM. While the Reserve Bank did not provide any direct support to LTCM, its role in facilitating the meetings might lead some market participants to expect Federal Reserve intervention should a large bank encounter financial problems. This may be a particular concern given that LTCM was a hedge fund, not a bank, and accordingly did not have a federal supervisor or an important role in the payments system. If credit spreads declined due to a strengthening in the conjectural value of a too-big-to-fail policy, that effect is swamped in our data by the liquidity impact of LTCM.

Thus, the finding that LTCM may have increased the liquidity spreads on bank subordinated debt tends to support the recommendation of Evanoff and Wall (2000a, 2000c) to set the threshold for supervisory action based on the Baa spread.[21] However, as discussed in those studies, there are data issues that should be further evaluated and further work looking at the Baa spread during this period would be necessary to confirm the benefits of using the Baa spread.

6. Summary and policy implications

The ability of PCA to limit supervisory forbearance is substantially weakened by its reliance on capital adequacy ratios where the measure of capital is under the control of banks and their supervisors. One potential complement to capital adequacy ratios would be to use a risk measure extracted from market prices. Perhaps the biggest objection from supervisors to the use of a market-based risk measure is that the measure may signal that a bank should be disciplined even though the supervisor's information suggests the bank is low risk. The risk measures extracted from market prices may contain such

[21] For a discussion of data issues see Evanoff and Wall (2002).

errors, largely because financial market prices incorporate more than the credit riskiness of the issuer.

This study addresses the concern with using market risk measures both theoretically and empirically. The theoretical section of the paper shows that the use of an imperfect risk measure for PCA can improve outcomes even if the supervisor has perfect information. The reason for the improvement is that the benefits from limiting forbearance may more than offset the gains from the supervisor's superior information.

The empirical analysis focuses on one particular risk measure, the yield spread of subordinated debt securities over comparable maturity Treasury securities. This part of the study uses the methodology that Evanoff and Wall (2002) applied to subordinated debt spreads over Baa bonds. The advantage of using spreads over Treasury securities is that the spread over Treasuries may more accurately capture the probability of failure over the business cycle, albeit at the cost of potentially making the standard more pro-cyclical. The current quality of the data may also be superior when Treasury spreads are considered. A potential cost of using the spread over Treasuries is that short-term market disruptions may affect private debt yields differently than that of Government debt. Thus, spreads over Treasuries may be more sensitive to short-term changes in liquidity and credit risk than would spreads over private debt yields (e.g., Baa bonds).

The results of examining spreads over Treasury securities suggest that subordinated debt yield spreads have substantial predictive power. However, the results also suggest that the spreads are an imperfect indicator, some high spreads were not accompanied by any other signs that the bank was high risk. Further analysis suggested that a substantial fraction of the apparent classification errors from using spreads over

Treasury securities may be due to an increase in the liquidity premiums on corporate bond issues in the wake of the collapse of LTCM. This finding suggests that not only do subordinated debt spreads appear to dominate the current capital measures used to trigger PCA, but that careful consideration should be given to determining which spread to use. The findings suggest that the merits of using a spread over a corporate bond index, such as Baa bonds, may exceed those of using alternative spreads and therefore deserves further consideration.

REFERENCES

Bank for International Settlement. 2001. "The New Basel Capital Accord." Consultative Paper Issued by the Basel Committee on Banking Supervision, June.

Benink, H. A. and C. Wihlborg, 2002. "The New Basel Capital Accord: Making it Effective with Stronger Market Discipline." *European Financial Management*, 8, pp. 103-115.

Cole, R.A. and J.W. Gunther. 1995. "FIMS: A New Monitoring System for Banking Institutions." *Federal Reserve Bulletin*, 81, pp.1-15.

Evanoff, D.D. and L.D. Wall. 2000a. "Subordinated Debt as Bank Capital: A Proposal for Regulatory Reform." *Economic Perspectives*, Federal Reserve Bank of Chicago, Second Quarter, pp. 40-53.

_____. 2000b. "The Role of SND in Bank Safety and Soundness Regulations." *Proceedings of a Conference on Bank Structure and Competition*, Federal Reserve Bank of Chicago, pp. 480-93.

_____. 2000c. "Subordinated Debt and Bank Capital Reform*." Research in Financial Services: Private and Public Policy*. edited by George Kaufman, Volume 12, JAI Press, pp. 53-120.

_____. 2001. "SND Yield Spreads as Bank Risk Measures*." Journal of Financial Services Research*, 20, pp. 121-46.

_____. 2002. "Measures of the Riskiness of Banking Organizations: Subordinated Debt Yields, Risk-based Capital, and Examination Ratings." *Journal of Banking and Finance*, 26, pp. 989-1010.

Flannery, M.J. 2001. "The Faces of 'Market Discipline'." *Journal of Financial Services Research*, 20, pp. 107-20.

Gilbert, R.A., A.P. Meyer and M.D. Vaughan. 2000. "The Role of a CAMEL Downgrade Model in Bank Surveillance." *Research in Financial Services: Private and Public Policy*. edited by George Kaufman, Volume 12, JAI Press, pp. 265-86.

Gunther, J. W., M. E. Levonian and R. R. Moore. 2001. "Can the Stock Market Tell Bank Supervisors Anything They Don't Already Know*?" Economic and Financial Review*, Federal Reserve Bank of New York, pp. 1-9.

Hancock, D. and M.L. Kwast. 2001. "Using Subordinated Debt to Monitor Bank Holding Companies: Is it Feasible?" *Journal of Financial Services Research,* 20, pp. 147-88.

Krainer, J., and J.A. Lopez. 2001. "Incorporating Equity Market Information into Supervisory Monitoring Models." Presented at a Conference on Banks and Systemic Risk, sponsored by the Bank of England, London (May 24).

Kwast, M.L., D.M. Covitz, D. Hancock, J.V. Houpt, D.P. Adkins, N. Barger, B. Bouchard, J.F. Connolly, T.F. Brady, W.B. English, D.D. Evanoff, and L.D. Wall. 1999. Using SND as an Instrument of Market Discipline. *Report of a study group on subordinated notes and debentures*. Board of Governors of the Federal Reserve System, M. Kwast (chair), Staff Study No. 172, December.

President's Working Group on Financial Markets. 1999. *Hedge Funds, Leverage, and the Lessons of Long-Term Capital Management*.

Sironi, A. 2001. "An Analysis of European Bank's SND Issues and its Implications for the Design of a Mandatory Subordinated Debt Policy." *Journal of Financial Services Research*, 19, pp. 233-66.

Table1: Binomial model predicting CAMEL ratings as a function of capital ratios and debenture spreads over the Treasury rate

Variable	Parameter Estimate (1)	Parameter Estimate (2)	Parameter Estimate (3)	Parameter Estimate (4)	Parameter Estimate (5)
Intercept	-5.2195 (0.0001)	-3.0839 (0.1008)	1.2028 (0.5061)	-1.3070 (0.4499)	-4.5877 (0.0001)
Sub-debt spread over Treasuries					1.1047 (0.0038)
PCA capital adequacy status	1.5700 (0.0525)				
Total risk based capital ratio		-0.0352 (0.8155)			
Tier 1 leverage ratio			-0.7052 (0.0119)		
Tier 1 capital to risk-weighted exposure				-0.2622 (0.2083)	
Association of Predicted Probabilities and Observed Responses					
Concordant	14.8%	43.2%	65.9%	54.8%	76.8%
Discordant	3.1%	35.4%	30.8%	40.3%	19.0%
Tied	82.1%	21.4%	3.3%	4.9%	4.2%
Gamma	0.656	0.099	0.363	0.152	0.604
% Correct	94.0%	23.2%	55.3%	38.9%	58.0%
% 3 - 4 Correct	15.4%	0%	69.2%	53.8%	69.2%
% 1 - 2 Correct	96.4%	23.9%	54.9%	38.5%	57.6%
Chi-square for covariates	2.259	0.058	6.402	1.797	6.475
(p - value)	(0.0967)	(0.8098)	(0.0114)	(0.1801)	(0.0109)

The results are from Evanoff and Wall (2001). The dependent variable takes a value of 0 for CAMEL (or BOPEC) ratings 1 and 2, and a value of 1 for ratings 3 and higher. The PCA capital adequacy status ranges from 1 for the best capitalized banks (well capitalized) to 5 for the least well capitalized (critically undercapitalized). The *p* values for the maximum likelihood parameter estimates are in parentheses below the coefficients. The "Chi square for covariates" statistic is based on the log likelihood statistic, and tests the marginal explanatory power of the independent variables relative to a model with only a constant term. The associated p values are included in parentheses.
Concordance is a measure of the correlation between the observed and predicted probabilities of the dependent variable. A pair of observations is said to be concordant if, based on the model, the observation that has a particular rating has a sufficiently higher probability of receiving that rating than does the other observation. A pair is discordant if the reverse is true. A pair is tied if the probability interval between the two observations is sufficiently small, 0.002. A correlation index, the Goodman-Kruskal Gamma index, is also included for assessing the predictive power of the model and for making comparisons across models. If *nc* is the number of concordant pairs and *nd* the number of discordant pairs, then the Goodman-Kruskal Gamma = (*nc* - *nd*) / (*nc* + *nd*). See Goodman and Kruskal (1972). Generally, the index approaches zero as independence between the two measures increases. Number of observations = 452.

Table 2
Means of bank capital and downgrade probabilities across subsamples

	Predicted 'good' banks* (1)	Predicted 'problem' banks* (2)
Risk based capital	12.5%	12.2%
Tier-1 leverage	7.08%	6.99%
Tier-1 risk-based	8.85%	8.56%
Early-warning model: GMV-1	1.0	4.77
Early-warning model: GMV-2	1.0	7.9

* A "problem bank" is one which has a subordinated debt issue trading at a yield spread equal to or greater than 84 basis points over a maturity matched Treasury bond. The early warning model measure is normalized to one for the predicted 'good' banks; thus the other measures are relative to the normalized category.

Table 3
Analysis of projected problem banks based on subordinated debt yields:
Identification of banks with explicit reasons for high spreads

Ranking by spread (1)	Less than satisfactory examine rating (2)	Potentially noisy data (3)	Unexplained observations with satisfactory regulatory ratings and no noisy data (type-2 error) (4)
1-25	2	14	9
26-50	4	8	13
51-75	0	8	17
76-100	2	6	17
101-125	1	7	17
126-150	0	12	13
151-175	1	7	17
176-193	0	5	13

Table 4
Analysis of projected problem banks based on subordinated debt yields:
Debt spreads of at least 84 basis points over Treasury yields

Ranking by spread	Unexplained observations*	Remaining observations with one or more indicators of a problem (All relevant categories noted)					No indicator of a problem or data noise
		Re-examined within 6 months	Rated less than satisfactory within 1 year	High early warning score	Market–to-book less than 1.0	Rated Baa	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1-25	9	3	1	9	2	2	3
26-50	13	1	1	3	2	1	7
51-75	17	5	2	4	0	4	8
76-100	17	4	0	7	1	5	8
101-125	17	6	0	5	0	2	7
126-150	13	7	0	5	1	3	5
151-174	17	5	1	4	1	4	6
176-193	13	6	2	3	1	3	3

* Observations remaining after deleting observations with unsatisfactory examine ratings and those observations from banking organizations not among the largest 30 by asset size in the year of the observation.

Table 5
Subsample analysis of projected problem banks based on subordinated debt yields:
Identification of banks with explicit reasons for the high spread

--excluding the post-Long-Term Capital Management period--

Ranking by spread (1)	Less than satisfactory examine rating (2)	Potentially noisy data (3)	Unexplained observations with satisfactory regulatory ratings and no noisy data (type-2 error) (4)
1-25	6	10	9
26-50	2	6	17
51-75	1	9	15
76-100	1	16	8
101-118	0	5	13

Table 6
Subsample analysis of projected problem banks based on subordinated debt yields:
Debt spreads of at least 84 basis points over Treasury yields

--excluding the post-Long-Term Capital Management period--

Ranking by spread	Unexplained observations*	Remaining observations with one or more indicators of a problem (All relevant categories noted)					No indicator of a problem or data noise
		Re-examined within 6 months	Rated less than satisfactory within 1 year	High early warning score	Market–to-book less than 1.0	Rated Baa	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1-25	9	1	2	5	4	1	1
26-50	17	5	2	6	1	4	5
51-75	15	9	0	8	1	4	3
76-100	8	4	0	3	3	2	1
101-118	13	5	1	2	1	4	4

* Observations remaining after deleting observations with unsatisfactory examine ratings and those observations from banking organizations not among the largest 30 by asset size in the year of the observation.

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