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Measures of the Riskiness of Banking Organizations:
Subordinated Debt Yields, Risk-Based Capital,
and Examination Ratings

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Measures of the Riskiness of Banking Organizations: Subordinated Debt Yields, Risk-Based Capital, and Examination Ratings

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Abstract: Recently there have been a number of recommendations to increase the role of subordinated debt (SND) in satisfying bank capital requirements as a preferred means to discipline the risk-taking behavior of systemically important banks. One such proposal recommended using SND yield spreads as the triggers for mandatory supervisory action under prompt corrective action guidelines introduced in U.S. banking legislation in the early 1990s. Currently such action is prompted by bank capital ratios. Evidence from previous research suggests that yield information may be a better predictor of bank problems. This paper empirically analyzes potential costs and benefits of using SND signals to trigger prompt corrective action.

JEL classification: G28, G21, G14, K23

Key words: bank regulation, subordinated debt, capital adequacy, prompt corrective action

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1. Introduction

The consensus of recent research is that subordinated debt spreads increase as a bank's risk

increases.[1] Building on this research and the current efforts to revise the Basel Capital Accord, a

number of proposals have been offered to increase the role of subordinated debt (SND) in bank

capital requirements.[2] The underlying premise of these recommendations is that increased

reliance on SND could aid in achieving the regulatory goal of improved bank risk management

either directly through the steady application of market discipline or indirectly through the

incorporation of market information into the supervisory process. Of particular interest is the

potential for improved risk management for larger, complex institutions most often associated

with systemic risk.

Although most of the existing literature provides general support for increased use of

SND, few papers directly address the questions of whether SND could provide more direct

discipline or assist the supervisors in measuring banks' risk exposure. Bliss and Flannery (2001)

point out that demonstrating that SND yield spreads are correlated with bank risk measures does

not imply that banks will actually respond to changes in these yields. They seek to address the

question of whether banks respond to changes in SND yields on existing debt and fail to find

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[1] See Flannery and Sorescu (1996), DeYoung, Flannery, Lang and Sorescu (2001), Jagtiani, Kaufman, and Lemieux
(1999), and Morgan and Stiroh (2000, 2001).

[2] For a discussion of the existing Capital Accord, problems associated with it, and proposed changes to it see Bank
for International Settlement (2001). Several recent papers advocate the increased use of subordinated debt,
including Benink and Schmidt (2000), Calomiris (1997, 1998), Evanoff and Wall (2000a), Ferguson (1999), Meyer
(1999), Moskow (1998), and U.S. Shadow Regulatory Committee (2000).

evidence of such a response.[3] Evanoff and Wall (2001) focus on the potential for SND to enhance the effectiveness of prompt corrective action (PCA) by using SND yield spreads as a complement or substitute for capital ratios to initiate supervisory action. As such, their focus is on comparing the accuracy of capital ratios and yield spreads as predictive measures of risk. They find that SND yield spreads predict the best available risk measure-- supervisory exam ratings-- better than the existing capital adequacy ratio triggers currently used for PCA.

This paper focuses more specifically on the potential benefits and costs of using SND yield spreads as triggers for PCA. Although Evanoff and Wall (2001) find that yield spreads are better risk measures than are capital adequacy ratios, they also find that the yield spreads identified many more banks as being high-risk than did the examiners. An examination of these differences may help in refining plans to use SND for PCA purposes as well as help identify the costs and benefits of such a proposal.

The methodology in this paper is to examine those observations classified as high-risk by SND yield spreads but as low-risk by the supervisors.[4] These observations are divided into three categories. The first category is those cases where the spread measure appears to be an

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[3] While the distinction Bliss and Flannery draw between pricing risk and disciplining risk is a valuable contribution, their empirical analysis should be regarded as a first attempt to address a difficult empirical question. See Evanoff and Wall (2000c) for a number of caveats regarding their findings. Most importantly, the analysis ignores the potential proactive influence of SND, as issuers will prudently manage their risk positions and adopt less risky portfolios *ex ante* to avoid the potential higher risk premiums that debtholders will demand for riskier positions. Moreover, even if one accepts their finding that bank risk taking is not influenced by SND as currently structured, such a finding does not imply that properly structured SND could not induce greater discipline. Currently there are significant restrictions on the characteristics of SND—including maturity—that will allow it to qualify as regulatory capital. Existing theory on the effect of debt maturity on firms' incentive to undertake more risky projects, as summarized for banks by Flannery (1994), would suggest that SND as currently structured with original maturities of at least five years could even have perverse effects on banks' incentives to invest in shorter-term, high-risk projects. This theory would suggest that if SND is to be used to induce greater direct discipline it should be shorter-term debt.

[4] Supervisors retain the authority to act independent of the PCA signals under FDICIA and would retain that power under Evanoff and Wall (2000c). Thus, banks that are identified as high-risk by the supervisors but not by SND yield spreads would not generate any costs if SND is used for PCA because these banks would be disciplined by the supervisors regardless of the signals.

especially noisy measure of bank risk, such as the spreads of smaller banks. Analysis of these banks may help in refining proposals to use SND yield spreads by indicating banks that should probably not be considered under the proposal and by suggesting areas where the spread measure needs to be improved.

The second category contains observations where there is no evidence that the bank is high-risk. Threatening to exert discipline on these banks would be the cost of using yield spreads in PCA albeit this cost might be reduced by increasing the spread required to trigger PCA.

The third category consists of the observations where a variety of alternative risk measures provide significant evidence that the SND yield spread measure is accurately identifying high-risk banks. These observations represent the potential gains from using SND yield spreads to discipline banks. In most cases, we cannot state with certainty that these banks should have been disciplined for several reasons: (1) the lack of any definitive criteria on which banks should be disciplined, (2) the consequent lack of empirical support for any set of criteria, and (3) the fact that none of the available risk measures provide a perfect ordinal risk ranking, let alone a perfect cardinal risk measure. However, even if many of the high-risk banks with high SND spreads would not be disciplined under existing supervisory policies, these banks might have adopted a lower risk profile if they had been operating in an environment where PCA could be triggered by SND yield spreads.

The next section discusses the rationale for using SND yield spreads for PCA. Section 3 reviews the empirical analysis, which serves as a starting point for a more in-depth analysis of observations for which SND signals differ from supervisory ratings. In Section 4 we discuss the methodology for empirically analyzing these observations. Section 5 presents the results of the

analysis, and the final section discusses the policy implications, and suggests future research directions.

2. Supervisory management of bank risk

An important part of the Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA) is its provision for prompt corrective action (PCA). The PCA provisions established five categories based on the adequacy of a bank's capital relative to measures of its risk exposure. A bank is subject to progressively stricter limitations and more supervisory intervention as its capital adequacy measures decline. If a bank's capital-to-total-asset-ratio falls below 2%, then the bank is placed in the lowest capital adequacy category (critically undercapitalized) and would generally be required to either increase capital or be closed within ninety days. The intent of the authors of PCA was to prevent costly failures by forcing supervisors to intervene early in an attempt to prevent banks from failing, and to force early resolution if the bank's capital became inadequate to protect the deposit insurance fund.

The continued efficacy of PCA based on capital adequacy ratios is being called into question, however, as advances in large banking organizations' ability to measure and manage their risk exposure enable them to arbitrage the risk-based capital requirements. As a result of these advances, the Director of Bank Supervision and Regulation at the Federal Reserve Board of Governors argued that "simple–ratios--including risk-based capital –ratios--and traditional rules of thumb no longer suffice in assessing the overall capital adequacy of many banking organizations."[5]

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[5] See Spillenkothen (1999). For a discussion of the ability of banks to exploit current risk-based capital requirements see Jones (2000). Additional questions have also recently been raised about PCA procedures as a result of their apparent ineffectiveness in the failure of Superior Bank FSB, where losses to the U.S. bank insurance fund are expected to exceed $500 million.

One way to address the problems with current capital adequacy ratios would be to develop more sophisticated ways of measuring capital adequacy. The Basel Committee on Banking Supervision has proposed three new capital adequacy frameworks to replace the 1988 Accord: a standard approach and the internal ratings based approach and the advance internal ratings based approach. However, the proposed standard approach may be subject to many of the same problems as the existing Accord as banks continue to enhance their ability to measure and manage risk. The two ratings based approaches rely on banks' internal risk ratings, which avoids the problem of banks exploiting weaknesses in the standard model. However, a potential problem with the internal ratings based approaches is with the verification of individual banks' internal ratings, especially given that the use of these ratings to trigger supervisory discipline would provide additional incentive to build ratings models that under-estimate risk. That incentive would intensify at the very time that supervisory intervention would be most needed.

In addition to the proposed Basel approaches, an alternative approach to improve the current Accord and PCA is to explore market-based risk measures as a substitute for (or complement to) accounting ratios.[6] In particular, the use of the yield on subordinated notes and debentures may provide an especially attractive alternative risk measure. Given that when banks fail any losses in excess of the bank's equity are first borne by the SND holders, potential investors can be expected to be very sensitive to an individual bank's risk exposure. Moreover, these investors would have an incentive to identify banks that were providing misleading estimates of their risk exposure and to require higher rates of return from these banks. The debtholders would also be less willing to forbear or delay reacting to perceived problems. Thus,

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[6] There are various means by which SND spreads could be incorporated into PCA. Evanoff and Wall (2000c) propose that the current use of bank capital tripwires for the various PCA categories be replaced with SND spread tripwires. This proposal is based on the contention, with empirical support, that the spreads more closely relate to bank risk than do the capital measures.

using SND yields for PCA purposes has the potential for substantially reducing the incentive to engage in capital arbitrage and the ability to engage in forbearance.

3. Alternative measures of bank risk: A starting point

The starting point of our analysis is to contrast the relative accuracy of alternative capital ratios and SND spreads in predicting bank condition. Bank condition is measured as subsequent CAMEL or BOPEC ratings.[7] While the methodology is the same as that used in Evanoff and Wall (2001), our objectives differ significantly. Evanoff and Wall (2001) were interested in evaluating the predictive power of alternative capital ratios relative to that of SND spreads. They found that SND spreads outperformed most of the capital measures, including the measure currently used to trigger PCA. Capital measures were shown to add very little predictive power once the SND spread was accounted for.[8]

For the current analysis we estimate alternative single-variable logit models to contrast the predictive power of SND spreads vis-à-vis capital measures. We stress the single variable models because most PCA proposals use a single indicator variable to trigger supervisory intervention. If SND spreads perform relatively well, we will use the SND models as a starting point to more fully evaluate observations where SND predictions do not coincide with

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[7] These are measures of the composite financial condition of the bank or bank holding company, respectively, as summarized by the federal banking agencies. Each letter summarizes an important element of bank condition. CAMEL accounts for the bank's condition with respect to capital adequacy, asset quality, management quality, earnings, and liquidity (sensitivity to market risk has also been added in recent years). BOPEC accounts for the holding company's bank subsidiaries, other non-bank subsidiaries, the parent company, consolidated earnings, and consolidated capital adequacy.

[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 SND certainly care about supervisor's evaluations and supervisors have demonstrated a strong interest in capital ratios. Supervisors may also care about SND yield 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 SND yield spreads influenced examiners is impossible to determine without additional information; however, discussions with examiners suggest that supervisors were not placing much weight on SND yield 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.

supervisory ratings. 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).

Below we review the data and summarize the empirical findings.

3.1 Data

We use the data developed by 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 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.

If a bank has multiple bonds outstanding, the first bond in the sample is the bond with the largest outstanding issue with pricing information on Bloomberg. This bond is then tracked until maturity. If the bond matures during their sample period, data are gathered on a replacement issue. Once again, if multiple bonds are outstanding, the replacement bond is the bond with the largest outstanding face value at the time the initial bond matures. The replacement bond is substituted for the original bond at the date of issuance of the replacement bond. The substitution occurs at the date of issuance rather than at the date the original bond matures to improve the quality of the measured yields. Bonds become less liquid as they approach maturity, and Hancock and Kwast (2001) find that market liquidity is an important determinant of the information content of SND.

Much of the analysis in Evanoff and Wall (2001) uses SND yield 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 SND yield Bloomberg and the calculated yield on a comparable maturity Treasury security.[9]

Two sets of corporate bond yield indices for Aaa and Baa bonds with three different maturity groupings (1-5 years, 5-10 years, and 10 years or more) are also collected. These indices are constructed from the universe of banks in the Warga-Lehman Brothers Fixed Income Database for the years 1990 and later. The data are indices created for Bliss and Flannery (2001). The corresponding spreads are then calculated by subtracting the maturity-matched corporate yield from the SND yield.

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 bank holding company level. The 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 321 observations from the data in Evanoff and Wall (2001) that contains complete information on the bond spreads over Aaa and Baa indices. Within this subsample there are eight banks rated 3 or lower. This subsample of 321 observations is the focus of our analysis.

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[9] 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 single-variable logit models to predict supervisory exam ratings are presented in Table 1. The results for the SND spreads over Baa and Aaa yields (columns 1 and 3) are identical to those in Evanoff and Wall (2001). While the other estimates are new and based on the smaller subsample of observations for which we have corporate bond data, the results are similar to those found for single-variable models in Evanoff and Wall (2001).   They indicate that SND spreads over both maturity matched corporate indices (*Sub-debt spread over Baa maturity-matched bonds* and *Subdebt spread over Aaa maturity-matched bonds*) and over Treasuries (*Sub-debt spread over Treasuries*) provide greater predictive power than the current PCA capital adequacy standard (*PCA capital adequacy status*). 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*. The performance of SND spreads satisfies an important prerequisite for using SND to initiate PCA.   However, even though 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. These differences are a prerequisite for generating cost and/or benefits from using SND for initiating PCA. Further 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 microanalysis of the misclassifications

This section considers the empirical methodology used to analyze the prediction errors resulting from using the debt spreads to predict risk levels as proxied by supervisory ratings. To start we address the issue of whether debt spreads and supervisory ratings are measuring the

same risk. The SND yield reflects only expected losses to the holders of SND while the primary

concern of supervisors may be the probability of failure. Thus, the misclassifications may simply

result from measuring different risks. We then turn to the issue of determining which

misclassifications should be evaluated. Given that we provide estimates for SND yield spreads

over comparable-maturity Treasury securities, Aaa corporate bonds, and Baa corporate bonds.

Which spread would be most useful for future policy purposes? Finally, we consider methods for

determining the source of the differences in bank classification between debt spreads and

supervisory ratings. 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 SND spreads may be a better indicator of bank risk than the model projects.

4.1   *Are examination ratings and SND spreads measuring the same risk*?

The underlying assumption in our analysis is that examination ratings and debt spreads

are alternative indicators of bank condition. As such, spreads could be used either as a tool for

supervisors to initiate a more critical review of the bank or as a more forceful tool to initiate

PCA. However it is possible that the two indicators are taking different time horizons into

account in that bank examination ratings, similar to current capital measures, are indicative of the

current condition of the bank while debt yields may be associated with a longer forecast horizon.

If this is the case, then discrepancies between the two measures may not be surprising.[10]

While theoretically possible, in practice the time horizon distinction between the two

measures may not be all that significant. While debt spreads are forward looking, they are

heavily based on the current condition of banks because that is most likely the best available

predictor of future performance. While expected performance should influence the yield, there

may be significant uncertainty as to future performance and those expectations will be

discounted when deriving the price on the debt. Similarly, there are reasons to believe that

examination ratings may be more forward-looking than some might expect. Rosen (2001) argues

that, to the extent possible, examiners attempt to be forward-looking to address current problems

before they cause more extensive problems. Obviously, if examiners are aware of a condition

that has not yet affected the bank's performance but has potential adverse future implications,

they would incorporate that information into the rating. The potential for supervisors to know

more than is reflected in accounting ratios was the reason for allowing U.S. regulators to initiate

PCA procedures even if the accounting tripwires introduced in FDICIA had not yet been

triggered. Similarly, there is evidence suggesting that examiners may extend an examination

cycle without finalizing the bank rating to allow it to initiate corrective procedures in an attempt

to improve future performance. The improved expected condition of the bank is then

incorporated into the rating. Thus, there are reasons to expect SND to be less forward-looking

and examination ratings more forward-looking than one might initially expect. That is, the time

period over which the two measure risks may not be all that different. In our analysis, we

assume they are comparable.

However, even if one accepts the contention that there is a mismatch in the time horizon

of the two measures and debt yields are more forward looking, signals from the SND market are

still valuable. Indeed, they may be more valuable as a complementary signal to the extent that

they signal future problems whereas supervisors focus on current problems. If this time horizon

differential is assumed to exist, then for discrepancies between the SND spreads and supervisory

ratings that cannot be explained more credence should be given to the signal from the debt

markets.

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[10] This potential issue and a discussion of its potential were raised by an anonymous referee.

4.2 Which misclassifications should be analyzed?

Evanoff and Wall (2001) examine a variety of spread measures, in part to examine the unique properties of the different measures. In this study we focus on the spread over the lowest investment grade debt category—Baa rated. This choice was made for a number of reasons.

First, whatever the merits of using an SND spread over comparable maturity Treasury securities (which is shown to perform relatively well in Table 1), the market for Treasury securities will almost surely become substantially less liquid over the next decade. The Social Security System is expected to run large surpluses that by law must be invested in Treasury securities. Unless the remainder of the federal government runs very large deficits, which virtually no analysts are expecting, then the supply of Treasury securities in the public's hands will shrink dramatically. Thus, supervisors may have little choice but to use the spread over a corporate index if SND yield spreads are to be used for PCA purposes anytime within the next decade.

In contrasting the usefulness of corporate bond indices to different debt rating categories, the most relevant issue concerns the variability of the alternative indexes over the business cycle, and not the level at any particular point in the cycle. Differences in levels at any given point may be adjusted for by setting the spread over (or under) the index used to trigger PCA. For example, if the spread between Aaa bonds and Baa bonds is 75 basis points at the trough of a business cycle, then setting a trigger at 100 basis points over Aaa bonds would produce similar results at the trough as setting a trigger over Baa of 25 basis points. However, for any given maturity, an index of Baa bonds will vary more over the business cycle than will an index of Aaa bonds. Suppose, for example, that the typical spread between Baa and Aaa debt during the peak of the business cycle is only 30 basis points and spreads are set to have an equivalent impact during a

recession. Then the yield spread over Aaa to trigger PCA at the peak of the cycle would remain at 100 basis points. However, if the Baa index were used to trigger PCA it would occur at 55 basis points over the Aaa index (i.e., the 30 basis points spread between Aaa and Baa plus the trigger of 25 basis points over Baa).

Is this greater variability over the business cycle good or bad? If changes in the spread between Aaa and Baa rated bonds are due solely to changes in expected default rates and if the optimal trigger point is constant across the business cycle, the less variable Aaa index may be preferred. Otherwise, the Baa index may be preferable. Do these conditions hold true? While there is some reason to believe that the cost of bearing default risk increases over the business cycle, a large part of the variation in Baa rated bonds appears to reflect changes in expected default rates over the business cycle.[11] While the spread between the Aaa and Baa cannot be perfectly decomposed into differences in expected losses and changes in the cost of bearing risk, it would be difficult to argue that most of the variation is driven by changes in the cost of bearing risk.

Thus, the determining factor appears to be whether the optimal trigger point varies over the business cycle. We are not aware of any well-specified theoretical model that addresses this question, let alone any effort that calibrates such a model to real data. Indeed, we are not aware of any attempt to measure an essential input of such a model, the cost of disciplining a sound bank. However, there are two arguments suggesting that the cost of disciplining may indeed vary over the business cycle.

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[11] Altman and Bencivenga (1995) use a simple empirical model to analyze changes in yield spreads for high-yield bonds, including Baa bonds. Their analysis may be interpreted as suggesting variation in the premium for bearing credit risk through time. However, a full understanding of the premium for bearing credit risk likely requires empirical estimation of a more sophisticated model, such as the theoretical model of Jarrow and Turnbull (2000). We are not aware of any paper using such a model that tries to measure the extent to which credit risk premiums vary due to increases in default risk versus changes in the cost of bearing credit risk.

Supervisors have long argued that the mistakes that cause a bank to fail are typically made during booms and are merely revealed by financial distress and failure during economic slowdowns. This line of reasoning suggests that the supervisors should impose tighter requirements during periods of economic strength to discourage excessive risk taking, which is when spreads between Aaa and Baa bonds are near their low points. As the above example illustrates, calibrating spreads over a Baa index to produce similar results to spreads over Aaa during an economic slowdown will result in spreads using the Baa index being more restrictive during economic booms.

Another argument frequently made is that the costs of disciplining banks are greater during recessions than during expansions because doing so during recessions may reduce bank lending and exacerbate the decline. This somewhat contentious argument has focused most recently on the potential procyclicality of bank capital standards [see Blum and Hellwig (1995), Kwast et al. (1999), Clementi (1999), Meyer (1999), Carpenter, Whitesell and Zakrajsek (2001), Altman and Saunders (2001), Borio, Furfine, Lowe (2001), and Danielsson, et al. (2001)]. [12] The procyclicality also arises if SND spreads are used to initiate supervisory action, and the extent of the problem varies with the basis used to calculate the spread. Returning to the earlier example, suppose that a PCA trigger is set to produce similar results at the peak of the business cycle, at 55 basis points over the Aaa index or 25 basis points over the Baa index. During an economic slowdown PCA will still be triggered at 55 basis points over the Aaa yield. However, to get the same effect, the yield on a bank's SND would have to rise to 100 basis points over the Aaa index if PCA is triggered by the Baa index. Thus, using spreads over Baa corporate bonds will partially address this "problem" as credit risk effects are embedded in both yields included in the

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[12] However, by its very nature, any form of regulation can be expected to be somewhat procyclical.

spread. The result is that spreads over Baa would not widen as much during slow economic

times as would a spread based on Aaa bonds.

Thus, a case may be made that the PCA trigger should be based on an index that varies

with the business cycle. This case provides a plausible basis for using the Baa index.

Furthermore, the most comprehensive proposal to date to use SND yields in PCA, Evanoff and

Wall (2000c), uses junk bond yields as triggers for PCA, rates that are more closely

approximated by the Baa rates than Aaa rates over the business cycle. Thus, while Table 1

reports logit regression analyses using spreads over Treasuries and Aaa yields, our primary focus

is on spreads over Baa yields.

4.3   *Method of analysis: Cases where yield spreads likely overestimated bank risk*

There are a number of potential reasons why using the SND spread may overpredict the

number of problem banks. The analysis below focuses on two reasons that are thought to be

particularly important for this study. First, the depth of debt markets for smaller institutions may

be somewhat limited. Most SND 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 SND issuance requirements.[13] As a rough first approximation, we consider any SND

issue by a bank not among the largest thirty in that year to be likely to have a higher liquidity

premium. These banks are then excluded from further analysis.[14]

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[13] For example, Evanoff and Wall's (2000a) proposal would require only the largest 25 banks to issue SND. 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.

Second, the available Baa indices group bonds into three categories based on their maturity.[15] This grouping results in a potential maturity mismatch between the maturity of particular SND issues and the Baa index. We find evidence of such a mismatch in that for some bank SND issues, the maturity-matched yield on Treasury securities exceeded the yield on the appropriate Baa index.[16] As a crude control for this maturity mismatch, we exclude all SND issues where the yield on its Baa index is less than 15 basis points over the yield on maturity-matched Treasuries.

4.4   *Method of analysis: Evaluating the accuracy of the yield spreads and examination ratings*

After accounting for the abovementioned potential data concerns, the remaining observations will be evaluated to determine when the SND yields identified a problem that was apparently not being reflected in the examination rating. 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 the lack of an independent measure of a bank's true 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 will be to use a variety of accounting and financial market measures to identify banks that appear to be financially distressed at the time of the examination or that appear to become distressed shortly after the examination.

We use two measures of supervisory concern about the bank. The first measure is whether the bank is been re-examined within a six-month period. Bank supervisors ordinarily go

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[15] We could not have avoided this problem with the Aaa indices because those bonds are grouped into similar maturity indices.

[16] The maturity matching is done by interpolating between the two Treasury securities closest in maturity.

at least one year between examinations. However, in some cases in our sample, the supervisors appeared to be substituting frequent exams for lower CAMEL ratings and discussions with examiners indicate that this procedure has been followed for some banks at certain times.[17] 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.

Accounting ratios are accounted for via parameter estimates from econometric models aimed at identifying problem banks. The econometric model approach is more likely to yield an objective risk measure; thus, we use what the U.S. bank regulatory agencies typically term "early warning models." These models use accounting data to identify potential problem institutions to help guide the use of examination resources.[18] If these models show that the banks identified by the yield spreads were good candidates for downgrades, that result would be consistent with SND yield spreads correctly signaling 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 satisfactory condition (CAMEL 3, 4 or 5) based on current accounting data. It is more flexible than other early warning models commonly used by supervisors in that it emphasizes the potential for a deterioration in bank

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[17] This indicator is not perfect. A follow-up exam 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 exam 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.

[18] 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.

condition rather than bank failure, a much more common phenomena 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.[19] The GMV ratings are obtained the paper's authors and the SEER risk rankings are obtained from confidential Federal Reserve supervision files.

Both SND ratings and common stock prices may yield information on the financial condition of banking organizations. We focus on the market-to-book ratio as a rough measure of the equity market's evaluation of a bank. Another plausible measure would be market-adjusted equity returns, but 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. Results consistent with the supervisors exercising forbearance would be: (1) low debt ratings, (2) the equity market measure indicating 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

Our empirical analysis focuses on 74 banks with SND spreads over Baa bonds of 25 basis points or more. The choice of 25 basis points, while partly arbitrary, is also based in part on the

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[19] For a discussion of the model see Cole and Gunther (1995) and GMV (2000). The SEER model is less flexible in

logit regression results in the first column of Table 1. Both the logit regression analysis and an arbitrary cutoff of 25 basis points correctly classify 6 of the 8 banks with CAMEL ratings of 3 or 4. This cutoff is also somewhat in line with the proposal of Evanoff and Wall (2000a) to tie PCA considerations to SND trading at yields comparable to those of below-investment-grade debt. This criterion also classifies 68 additional banks (20% of the highly rated banks) 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 SND 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, 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   *High-versus low-spread banks*

A comparison of the banks with high spreads versus those with low spreads is found in the first two columns of Table 2. The results presented in the first three rows suggests 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 under the FDICIA. This index is of particular interest since it is the measure currently being used to trigger PCA.

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that bank failures have been so rare during the 1990s that the parameter estimates have been frozen throughout the period.

Substantial differences, however, across the two subgroups can be seen 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.

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.[20] Results using the GMV-2 measure similarly suggest substantial differences. Results using the SEER model (not presented in the table) also indicate significant differences. As a summary measure of the differences, 4% of banks in the non-problem bank subsample have SEER measures greater than twice the overall sample mean. Over 40% of institutions in the problem bank subsample have SEER measures greater than twice the mean. Again, the two subsamples appear to be substantially different based on the problem-bank prediction models in spite of the fact that our SND model generates such a high number of misclassifications based on supervisory ratings.

The difference is even more pronounced if we account for potential noise in the data arising from the inclusion of smaller banks in the sample and imprecise maturity matching of the

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[20] 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

SND yields and the Baa bond indices. If we drop these observations, the contrasts between the two subgroups of banks are even more significant. The third column of Table 2 shows the capital ratios and early warning model indices for the predicted problem banks that suffer from potential noise in the data. The final column shows information for the remaining observations predicted to be problem banks.

While the adjustments result in some widening of the difference between the capital ratios of "good" and "problem" banks (not totally surprising given that the small banks are known to hold higher capital levels) the most apparent shift is the significant widening of the differences in the indexes from the early warning models. This difference in early warning indexes reinforces the contention that the two groups of banks are substantially different although most of them fell within the same rating category.

5.2   *Analysis of high spread banks*

In this section we separate banks with high spreads into two groups: those that we can explain as either being in agreement with supervisory ratings and those that may have significant noise in their yield spread measures. The remaining unexplained observations are then subject to further investigation.

The observations that are easily explained are summarized in Table 3. The 74 observations are first ranked by spread with a ranking of 1 assigned to the highest spread and a ranking of 74 assigned to the lowest spread. The observations are then separated by these rankings into four sets of 15, and a last set of the 14 observations with the smallest spreads (but greater than 25 basis points).   This procedure allows an evaluation of the decline in the accuracy

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sample of debt-issuing banks would not be a representative sample of banks from which the model parameter estimates were generated.

of the spread measure as yield spreads decline while at the same time providing ample protection for the confidentiality of individual bank exam ratings.

The second column contains the number of observations in each set where the bank is rated less than satisfactory (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 15 yield spreads, one bank was rated less than satisfactory by the supervisors.

The third column contains the number of observations with potentially noisy data, either because the observations came from a smaller bank or because it appeared to have a maturity matching problem. For example, five banks with spreads ranked between 16 and 30 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 (the vast majority of the selected items were for the GMV models). 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 there is no indication of higher risk.

The results in Table 4 suggest that a high proportion of the unexplained observations with high yield spreads had one or more indicators that the bank was high risk. Over one-third of the 32 unexplained observations, 12, were re-examined within six months. This number, combined with the six banks that were assigned less-than-satisfactory ratings suggests that almost one-half the banks that SND yield spreads suggested were high-risk, were also banks about which the supervisors had some concerns. One other interesting finding from Table 4 is that while a few of the banks were rated Baa, in general credit ratings appear to be less reliable measures of credit quality than the yield spreads.

After accounting for these indicators of above-average risk, we are left with seven bank observations with no obvious indication of problems. Six of these are bunched relatively close to the chosen trigger threshold, i.e., within twelve basis points (or the banks have spreads over the Baa index of less than 37 basis points). This bunching may suggest that a somewhat higher cutoff would be desirable, depending upon how one weighs the costs of disciplining a sound bank versus the costs of failing to discipline a weak bank.

5.3   *Summary and implications*

To summarize, from more thoroughly analyzing the observations for which SND yields and supervisory ratings indicate different risk levels, we are made aware of potential issues that need to be addressed if a SND program is to be introduced. First, signals from the SND market for smaller banks (most likely characterized by smaller issues and thinner markets) may entail liquidity premiums that makes the signal somewhat noisy and less reliable. This finding reinforces the findings of Hancock and Kwast (2001) and stresses the importance of past recommendations to limit SND programs to only the larger tier of banks. Additionally, the need for the collection of more accurate data from debt markets is indicated by the problems found

with matching the maturity of certain SND issues with that of corporate bonds. Finally, while the discrepancies between the SND and supervisory ratings initially appear quite significant, upon further evaluation it appears that supervisors may have been substituting examination discipline for downgrades as evidenced by the relative frequency of examinations for the misclassified observations. Once the examination frequency, additional accounting information, recent examination records, and market information are accounted for, few of the banks with high SND yield spreads appear to be low-risk. Moreover, most of the banks with high spreads but no evidence of above average risk were near our initial cut-off of 25 basis points. Thus, these results may suggest a cut-off point of 40 basis points would have been better than a cutoff of 25 basis points, depending upon the relative costs of type-I and type-II prediction errors.

6.   Summary and policy implications

Recent recommendations to increase reliance on market signals as a means to discipline bank behavior, particularly for systemically important banks, have generated significant interest in the existing relationship between SND yields and bank risk. This is another study in that vein. We find that spreads are related to measures of bank risk in spite of a number of methodological problems that arise in the use of SND spreads. While we are encouraged that use of SND information can become an integral part of the bank regulatory process, there are a number of issues that need to be addressed.

One of the more important issues deals with data availability. While Treasuries have advantages in that there is relatively rich information on the maturity structure, there are also problems in that spreads based on Treasuries could vary for reasons that are not related to the riskiness of a particular bank and the depth of the market could be affected in the future as the supply of bonds decreases. Concerning the use of corporate securities as the basis, the major

issue involves problems with accurately matching the maturity structure of bank and other corporate bonds. Thus, again there is the potential for noise in the data with no obvious means to appropriately adjust for maturity without the development of new data sources. There are additional problems for smaller banks as a result of the relatively thin market for their securities and the potential for a resulting lack of meaningful market revelation.

One issue related to the use of SND yields to initiate PCA concerns the quality of the signal and potential inflexibility on the part of the supervisors. That is, it has been argued that SND may be too blunt an instrument for use in PCA. However, there are a number of alternative means by which it could be incorporated into the PCA process without necessarily replacing capital ratios as the trigger to initiate prespecified actions, particularly in the short term until supervisors/regulators become more comfortable with the instrument and the markets develop and deepen. The current practice in the United States is to use the SND yields as an additional input in the supervisory review process in a manner similar to the way bank equity prices might be used. However, SND yield spreads are not to incorporated into PCA. This seems to result from the concern that binding enforcement might be somewhat draconian and could initiate unnecessary interventions [e.g., see Meyer (1999)]. Yet evidence suggests that excluding SND spreads from PCA limits PCA's effectiveness and permits forbearance. A potential compromise might be to have two PCA triggers: one driven by capital guidelines (with the current required supervisory actions) and one by SND spreads. However, with respect to the SND triggers, supervisors could satisfy their PCA requirements either by initiating the required corrective action when the trigger spreads are reached or by publicly documenting why the action is unnecessary. At a minimum the documentation will discourage forbearance, but it will allow

markets and supervisors to get use to the new PCA guidelines without the fear of unnecessarily draconian restrictions.

Finally, there also continues to be significant uncertainty in many quarters about the informational content of SND spreads. While much has been learned about the U.S. SND markets in recent years, there are still significant uncertainties concerning how effective such a program might be. As a result of the well-known Lucas critique, this is a classic Catch-22 problem. Until a mandatory SND program is initiated, the typical problems raised in this and other studies concerning the extraction of an accurate market signal from SND will most likely continue. Once initiated, a mandatory issuance policy will affect the depth and effectiveness of the bank SND market, and the behavior of regulated firms will most likely change significantly in response to the policy. Without going forward with such a program, there will continue to be concerns about market depth and the informational content in the yields. Issues about data noise, maturity structure, market depth, and distortions associated with imbedded options on some, but not all, issues will continue to dominate the debate. Given the apparent relatively low cost of implementing such a plan and the potential gains from its implementation, there appears to be merit in moving forward to give SND a larger role in the capital structure of larger banks and in the supervisory process.

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Table 1: Logit model predicting bifurcated CAMEL ratings as a function of capital ratios and debenture spreads over bond indices

Variable	Parameter Estimate (1)	Parameter Estimate (2)	Parameter Estimate (3)	Parameter Estimate (4)	Parameter Estimate (5)	Parameter Estimate (6)	Parameter Estimate (7)
Intercept	-3.9322 (0.0001)	-4.9847 (0.0001)	-4.0496 (0.0001)	-4.9509 (.0001)	-3.8400 (0.0615)	2.6367 (0.2472)	-1.3976 (0.5248)
Sub-debt spread over Baa maturity-matched bonds	1.7941 (0.0343)						
Sub-debt spread over Treasuries		1.4991 (0.0029)					
Sub-debt spread over Aaa maturity-matched bonds			1.0045 (0.0476)				
PCA capital adequacy status				1.1930 (0.2807)			
Total risk based capital ratio					0.0136 (0.9316)		
Tier 1 leverage ratio						-0.9632 (0.0089)	
Tier 1 capital to risk-weighted exposure							-0.2642 (0.3106)
Association of Predicted Probabilities and Observed Responses							
Concordant	73.3%	85.7%	58.9%	12%	0.3%	77.2%	51.3%
Discordant	24.0%	10.9%	36.1%	3.6%	16.7%	20.1%	44.2%
Tied	2.8%	3.4%	4.9%	84.4%	83.1%	2.7%	4.5%
Gamma	0.507	0.775	0.240	0.535	-0.967	0.586	0.075
Chi-square for covariates (p - value)	4.083 (0.0433)	8.0207 (.0046)	3.088 (0.0789)	0.8937 (0.3445)	0.0072 (0.9325)	7.2480 (0.0071)	1.1517 (0.2832)

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. Standard errors for the maximum likelihood parameter estimates and the p-value of the associated Wald chi-square statistic are printed in parentheses beneath the estimates. 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 = 321.

Table 2

Means of bank capital and downgrade probabilities across subsamples

	Predicted 'good' banks (1)	Predicted problem banks* (2)	Smaller predicted problem banks and banks with maturity matching problems* (3)	All other problem banks* (4)
Risk based capital	12.65%	12.88%	13.28%	12.54
Tier-1 leverage	7.04%	6.97%	7.48%	6.53%
Tier-1 risk-based	8.87%	8.95%	9.76%	8.26%
Early-warning model: GMV-1	1.0	4.53	1.80	7.25
Early-warning model: GMV-2	1.0	3.16	0.83	5.09

* A "problem bank" is one which has an SND bond issue trading at a yield spread equal to or greater than 25 basis points over a maturity matched index of Baa bonds. 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 SND projected problem banks:

Identification of those banks with clear reasons for the high spread

Ranking by spread (1)	Less than satisfactory examine rating (2)	Potentially noisy data (3)	Unexplained observations with satisfactory ratings and no noisy data (4)
1-15	1	10	4
16-30	0	5	10
31-45	3	7	5
46-60	0	5	10
61-74	2	9	3

Table 4

Analysis of SND projected problem banks:
SND spreads of at least 25 basis point spread over Baa 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)
1-15	4	1	1	3	1	1	1
16-30	10	5	2	5	4	4	0
31-45	5	1	1	5	1	1	0
46-60	10	3	1	1	1	0	5
61-74	3	2	0	0	0	0	1

* 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.