



# The relative contributions of equity and subordinated debt signals as predictors of bank distress during the financial crisis<sup>☆</sup>



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## ABSTRACT

Bank supervisors utilize early warning signals to predict which banks are likely to become distressed. Previous research has found that market discipline signals do not significantly improve out-of-sample forecasts relative to accounting-based signals. Most of that evidence, however, comes from periods in the 1990s when the U.S. economy and banking system were healthy, potentially neutralizing an advantage of market signals to incorporate new information quickly. For the period between the fourth quarters of 2006 and 2012, we assess the accuracy of two market signals – expected default frequency (EDF) and subordinated note and debenture (SND) yield spreads – relative to accounting-based signals in forecasting which publicly traded BHCs would become distressed. In 2008, EDF signals were relatively more accurate, but they did not lead to economically significant reductions in missed distress events relative to other signals. Supervisors would have been better off devoting slack resources to monitor BHCs with high commercial real estate concentrations. As the crisis subsided, a failure probability model developed from bank failures in the 1980s and early 1990s was consistently the most accurate signal. For the two dozen BHCs with actively traded SNDs, yield spreads over Treasuries were extremely poor predictors of distress because the spreads were distorted by too-big-to-fail subsidies. The Tier 1 leverage ratio was the most accurate distress signal for these large BHCs. In sum, the evidence to justify systematic reliance on market signals by supervisory agencies to forecast bank distress remains weak.

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## 1. Introduction

Over time, bank supervisory agencies have developed and employed early warning monitoring systems that predict financial distress.<sup>3</sup> These models rely exclusively on bank financial data and ratings information gathered from on-site examinations (Burton and Seale, 2005). Presently, supervisors use market signals in an

ad hoc manner as secondary sources of information because research has shown that, at best, adding market data to existing models only marginally improves their forecasting accuracy.

The financial crisis that erupted in 2008 provides an opportunity to reexamine the utility of market data in bank supervision. Previous research analyzed sample periods mostly in the 1990s where macroeconomic conditions were relatively stable and bank conditions changed slowly. It could be the case that because market signals update more rapidly than accounting signals in response to new information, market signals are the most valuable when bank conditions deteriorate rapidly.

Using data surrounding the financial crisis, we test the hypothesis that, relative to forecasts based on book measures alone, the systematic use of market-based signals by bank supervisors would have improved by economically significant amounts their ability to identify which bank holding companies (BHCs) became distressed. The market signals we analyze are expected default frequency (EDF) and yield spreads on bank subordinated notes and debentures (SNDs); book signals include a failure probability model,

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<sup>3</sup> See King et al. (2006) for an historical summary of supervisory early warning models.

capital ratios, commercial real estate (CRE) concentration, and a Z-score. We compute each distress signal monthly for each BHC between October 2006 and December 2011. For each month in the sample, we look forward up to 2 years and observe which BHCs became distressed. We define “distress” several ways for robustness. The primary definition is that a BHC is distressed if at least one of its subsidiary banks fails or receives FDIC open bank assistance during the forecast horizon. Alternatively, a BHC is distressed if its Texas ratio exceeds 100% or its public credit rating declines three or more notches.<sup>4</sup>

Forecasting accuracy is measured two ways. First, we regress the binary distress outcome variable on each distress signal to assess the magnitude and statistical significance of their correlation. Second, we rely on the ordinal properties of the distress signals to assess their economic significance in a manner consistent with how bank supervisors are likely to use the signals. Supervisors typically rank BHCs by a given risk metric and then make judgment calls about which organizations should receive additional attention. For each month in our sample period, we rank the BHCs by each signal from riskiest to safest and compute Type I–Type II areas under the curve and Type I error rates (missed distress events).

We find evidence that the real-time use of EDF signals by bank supervisors roughly between mid-2007 and year-end 2008 would have improved their ability to predict which of the publicly-traded BHCs would suffer a failure event; the improvement, however, was economically small. Indeed, a ranking of BHCs by their degree of CRE concentration resulted in lower Type I error rates. After 2008, the forecasting accuracy from EDFs was often worse than the accounting-based signals, especially compared with a probit failure probability model derived from bank failures in the 1980s and early 1990s. We conclude that early warning signals from EDFs did not improve forecast accuracy of BHC distress by economically significant amounts.

In addition to EDFs, we test separately the forecast accuracy of yield spreads for the much smaller “SND sample,” the set of banking organizations with liquid SNDs. We find no evidence that yield spread signals increased supervisory forecast accuracy. We show that yield spreads were distorted by too-big-to-fail (TBTF) subsidies at the largest BHCs in the months before September 2008, precisely when the signals may have proven the most valuable. In this sample of the largest BHCs, the Tier 1 leverage ratio was the most accurate predictor of BHC distress.

Our paper proceeds as follows. Section 2 reviews the relevant literature on the use of market signals in bank supervision and on the dynamics of bank distress during the financial crisis. Section 3 describes our methodology and defines the distress events and signals. Section 4 describes the data. Section 5 presents the results from logit analysis of BHC distress on market and accounting signals during the financial crisis. Section 6 presents the Type I–Type II methodology and results. Section 7 shows evidence consistent with the argument that SND yield spreads were affected by TBTF subsidies, and section 8 concludes.

## 2. Literature review

In this section we review the relevant research on the use of market discipline in bank supervision and highlight our study's contribution. The study most similar in purposes to ours is by Gropp et al. (2006), who examine a sample of European banks between 1990 and 2001. They find that market signals predict bank distress. Distance to default predicts bank downgrades 6–18 months

in advance; the prediction horizon for spreads, however, diminishes beyond 12 months. They also find that implicit government subsidies weaken the predictive power of spreads. However, they find complementarity between both indicators, and they find that adding market data to accounting information adds a small but not insignificant improvement in forecasting. Although the time period, continent, and methodology have no overlap, the only substantive difference between our results and Gropp et al. is that we fail to find that information from yield spreads complements information derived from EDFs or book measures. This difference is likely attributed to the fact that their primary event is a downgrade while ours is a failure so that the TBTF subsidy in our sample is stronger. Nevertheless, both papers find predictive ability for equity signals.

To the best of our knowledge, only one paper has studied market signals during the financial crisis. Milne (2014) analyzes distance to default (DD) for the 41 largest global banking institutions between 2006 and 2011 and finds that DD performed worse than traditional accounting measures. He finds that DD was a statistically significant predictor of bank failure only in the second half of 2008 when using data from mid-year 2008. He does not compute any ordinal measures of economic significance.

A number of papers using data from the 1990s utilize examination ratings to examine the ability of equity data to complement supervisory ratings. Krainer and Lopez (2004) find that EDFs contain information beyond traditional supervisory metrics, but inclusion of EDFs in a predictions rating model fails to improve out-of-sample BHC ratings forecasts. This result, however, may be driven by the relatively calm sample period from 1990 to 1999. Berger et al. (2000) find complementary information between bond, equity, and supervisory information, but they find few synergies between equity market information and supervisory assessments, and they do not use EDF as a market signal. Using data from 1996 to 2000, Gunther et al. (2001) find that EDFs provide incremental information between BHC inspections because EDFs are statistically significant variables in predicting ratings downgrades. The authors, however, do not test directly the relative accuracy of these models.

Much research has focused on the ability of SND yield spreads to forecast financial distress, and the results are tenuous. DeYoung et al. (2001) find that on-site examinations produce relevant information about the future safety and soundness of banks several quarters before the information is impounded in debenture prices. Flannery and Sorescu (1996) show that TBTF subsidies play an influential role in determining yield spreads. Spreads became sensitive to risk only after passage of the FDIC Improvement Act of 1991, which attempted to reduce the TBTF perception and impose more bank discipline. In perhaps the most careful study of yield spread sensitivity, Krishnan et al. (2005) examined SND signals between 1994 and 1999, and they also found evidence that SND yield spread levels were sensitive to firm risk. However, they failed to find strong and consistent evidence that changes in credit spreads reflect changes in bank-specific risks. They argued, therefore, that SND yields are not consistently reliable market discipline signals because the signal to noise ratio is too small.<sup>5</sup>

The Financial Services Modernization Act of 1999 contained a provision that the Federal Reserve and Secretary of the Treasury conduct a study of whether large BHCs should “maintain some portion of their capital in the form of subordinated debt in order to

<sup>4</sup> The Texas ratio is the sum of nonperforming assets divided by equity capital and loan loss reserves. Siems (2012) provides a succinct overview of this ratio.

<sup>5</sup> Subordinated debt may also deter bank risk-taking because managers are influenced by the threat of higher funding costs should they adopt riskier strategies. However, neither Bliss and Flannery (2002) nor Krishnan et al. (2005) find evidence of this preventative influence.

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