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The Potential Role of Subordinated Debt Programs in Enhancing Market Discipline in Banking

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Abstract: Previous studies have found that subordinated debt (sub-debt) markets do differentiate between banks with different risk profiles. This finding satisfies a necessary condition for regulatory proposals which would mandate increased reliance on sub-debt in the bank capital structure to discipline banks' risk taking. Such proposals, however, have not been implemented, partially because there are still concerns about the quality of the signal generated in current debt markets. We argue that previous studies evaluating the potential usefulness of sub-debt proposals have evaluated spreads in an environment that is very different from the one that will characterize a fully implemented sub-debt program. With a fully implemented program, the market will become deeper, issuance will be more frequent, debt will be viewed as a more viable means to raise capital, bond dealers will be less reluctant to publicly disclose more details on debt transactions, and generally, the market will be more closely followed. As a test to see how the quality of the signal may change, we evaluate the risk-spread relationship, accounting for the enhanced market transparency surrounding new debt issues. Our empirical results indicate a superior risk-spread relationship surrounding the period of new debt issuance due, we posit, to greater liquidity and transparency. Our results overall suggest that the degree of market discipline would likely be enhanced by a mandatory sub-debt program requiring banks to regularly approach the market to issue sub-debt.

Keywords: Financial regulations, market discipline, subordinated debt, bank capital

JEL classification: G21, G28, G38, L51

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The Potential Role of Subordinated Debt Programs In Enhancing Market Discipline in Banking

I. Introduction

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> "There is now general agreement that the markets are increasingly complex – making it more difficult for supervisors and regulators – and that *(bank)* supervision and regulation have significant costs and inefficiencies. As a result, we must begin to increase our reliance on market discipline both as a governor and as an indicator …. Sub-debt holders would therefore be expected to impose market discipline on the bank that is quite consistent with what bank supervisors are trying to do…" [Meyer (1998)]

There is a growing awareness that increased reliance on market forces by bank supervisors is necessary given the increasing level of complexity in the industry; particularly at the large complex banking organizations (LCBOs).[1] In fact, the new Basel Capital Accord (Basel II) proposes that market discipline be one of the three pillars supporting safety and soundness of the banking system. One recommended means of establishing more effective market discipline in banking would be to introduce a mandatory sub-debt component as part of the bank capital requirement. The basic contention is that mandating sub-debt issuance would force the bank to continually "pass the test of the market" and would provide signals to market participants of the condition of the bank. A sub-debt requirement could serve to produce both *direct* market discipline by increasing the funding costs for the bank, and *indirect* discipline by having bank supervisors respond to the signal from sub-debt spreads.[2] This has led to a number of reform proposals to formally introduce *mandatory* sub-debt requirements for LCBOs, since it is these institutions that are typically associated with systemic concerns of regulators.[3]

Previous research found that sub-debt spreads do indeed reflect an issuing bank's

[1] See Greenspan (2000), Ferguson (1999), Meyer (1999, 2000), Moskow (1998), and Bank for International Settlement (1999).

[2] To avoid the increased funding costs and adverse market signal, banks would operate in their own self-interest and prudently manage their risk. For discussion on the potential benefits associated with mandatory sub-debt programs, see Kwast, et al. (1999) and Evanoff and Wall (2000a,b).

[3] See Benink and Schmidt (2000), Calomiris (1997, 1998), Evanoff and Wall (2000a, b) and U.S. Shadow Regulatory Committee (2000).

financial condition [see Flannery and Sorescu (1996), DeYoung, Flannery, Lang and Sorescu (2001), Jagtiani, Kaufman and Lemieux (2002), Jagtiani and Lemieux (2001), Allen, Jagtiani and Moser (2001), and Morgan and Stiroh (2000 and 2001)], satisfying a precondition for sub-debt proposals to be effective. In addition, Evanoff and Wall (2001, 2002) suggest that sub-debt spreads may be more informative for identifying problem banks than are the current regulatory measures used to trigger 'prompt corrective action' by U.S. bank supervisors. Yet, a mandatory sub-debt program has not been implemented by bank regulators as there continues to be concerns about using the signal extracted from debt yields to monitor or predict the viability of banking institutions due to the current lack of market depth, trading frequency, heterogeneous debt characteristics, and infrequency of issuance.[4]

We contend that previous studies evaluating the potential usefulness of sub-debt programs are likely to have underestimated the potential impact of these programs. This occurs because the environment in which yields have been evaluated will most likely be very different from the environment characterized by a fully implemented, mandatory sub-debt program. A formal sub-debt program can be expected to induce a number of adjustments in financial markets. Specifically, debt markets will likely become deeper, issuance will become more frequent,[5] debt will be viewed as a more viable means to raise regulatory capital, more attention will be paid to individual bank debt yields, bond dealers will be encouraged by pressure from both the banks and the public to be less reluctant to publicly disclose actual debt transaction prices, and generally, markets will be more closely followed. With a mandatory sub-debt program in place, the market will most likely become more complete, making the resulting market signals more informative. Therefore, previous studies of the risk-spread relationship are likely to have underestimated the potential impact of sub-debt proposals, and concerns about the quality of the signal from these markets as a result of thin markets, heterogeneous debt instruments, etc., may

[4] See Board of Governors (2000), Bliss (2001), Bliss and Flannery (2001), Birchler and Hancock (2004), Hancock and Kwast (2001).

[5] Mandatory periodic issuance, e.g., twice a year, is typically one component of a comprehensive sub-debt proposal. Empirical evidence has suggested that riskier banks purposely avoid approaching the market with new sub-debt issues; one argument is they do this to avoid the resulting discipline of the market.

be mitigated in an environment with a fully implemented program. This difference between the current and potential future market is partially a result of the well known Lucas Critique in which firms respond to regulatory change and optimize within the new regulatory framework, with constraints that may be very different than those that existed before the change.

We take into consideration potential changes in the market environment brought about by a mandatory sub-debt program to improve the risk-spread relationship and the potential extent of market discipline by focusing on the performance of sub-debt markets at times when they probably most closely approximate the new proposed environment—the period surrounding new debt issues. Specifically, we postulate that current markets are "deeper," more transparent, and informative around initial placements, resulting in significantly different risk pricing behavior. We find empirical evidence consistent with this contention. Our prior is that after a sub-debt proposal has been fully implemented, the characteristics of sub-debt markets will be somewhat similar to what we find in today's markets around initial debt issues. Therefore, the actual market discipline imposed will likely be greater than that suggested in previous studies. Although our use of the new debt issuance period probably more closely approximates that which would exist with a mandatory sub-debt program, with a fully implemented program, debt markets will most likely become even deeper and more fluid than that seen around new issues in today's markets. Thus our analysis should be considered an improvement, but a lower bound measure of the potential increase in market discipline following the introduction of a mandatory sub-debt policy.

The paper proceeds as follows. We present the literature review in Section II. In Section III, we introduce our empirical approach for evaluating the extent to which sub-debt yields reflect bank risks and how the risk-spread relationship may differ in an environment with a mandatory sub-debt program. Our data and the empirical results are presented and discussed in Section IV. Finally, Section V summarizes and evaluates the policy implications of the analysis.

II. Literature Review

One proposed means of establishing more effective market discipline in banking would be to introduce a mandatory sub-debt component as part of the bank capital requirement. The basic contention is that mandating sub-debt issuance would force banks to continually "pass the test of the market" and would provide signals to market participants of the condition of the bank. To avoid the increased funding costs and adverse market signal, banks would operate in their own self- interest and prudently manage their risk. A sub-debt requirement could serve to produce both *direct* market discipline by increasing the funding costs for the bank, and *indirect* discipline by having bank supervisors respond to the signal from sub-debt spreads.[6]

These arguments have led to a number of reform proposals to formally introduce *mandatory* sub-debt requirements for LCBOs, since it is these institutions that are typically associated with systemic concerns by regulators [Benink and Schmidt (2000), Calomiris (1997, 1998), Evanoff and Wall (2000a, b) and U.S. Shadow Regulatory Committee (2000)]. For these proposals to have merit, holders of bank-issued sub-debt need to effectively price the riskiness of the bank into the required yields in a manner consistent with financial theory. This has been the focus of a number of recent studies, discussed below, which evaluate the relationship between sub-debt spreads and the risk characteristics of the issuing bank to determine whether debt holders demand a higher yield commensurate with the risk profile of banks.

Sub-Debt Spreads and Direct Market Discipline

It has been well documented in the literature that the market accounts for risk when pricing sub-debt of banking organizations. In addition, more recent research finds that bank managerial decisions appear to be influenced by the market's pricing of debt. When sub-debt spread was not found to be related to risk measures, there is evidence indicating that debt holders were not at risk in spite of the riskiness of the issuing bank -- partially due to the

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[7] The Federal Deposit Insurance Corporation Improvement Act (FDICIA) attempted to address the TBTF issue and eliminate the perception that debt holders were not at risk by requiring prompt corrective action by regulators and least cost resolution provisions. These provisions imposed a relatively stringent process on the FDIC before it could extend protection in a failed-bank resolution beyond insured deposits—the systemic risk exemption. There are still some evidence, however, that a perceived TBTF policy may still be in effect even after the FDICIA -- see Kane (2000), Penas and Unal (2004), and Brewer and Jagtiani (2007)].

government's conjectural guarantee. The guarantee was decreased in the U.S. via policy and legislative changes in the early 1990s, and debt holders (the markets) apparently responded by more accurately pricing risk, as debt holders no longer perceived themselves to be protected from losses.

Flannery and Sorescu (1996) examined secondary market prices and yields of sub-debt issued by bank holding companies (BHCs) during the 1983 to 1991 period. They found evidence of risk being priced in the more recent sub-period (1989-1991) when debt holders were thought to be subject to losses, but not during the earlier sub-periods (1983-1985 and 1986-1988). They argued that in the earlier sub-periods, there was a general perception that certain banks were too-big-to-fail (TBTF). That is, there was a conjectural guarantee for *all* liability holders at LCBOs during this period. Thus, yields were not risk sensitive because debt holders did not perceive themselves to be at risk.[7]

Jagtiani, Kaufman, and Lemieux (2002) added to the literature by extending the analysis into the post-FDICIA period and separately evaluated publicly traded sub-debt issued by *BHCs* and sub-debt issued directly by *banks*. Analysis of bank-issued sub-debt is important because most of the reform proposals recommend the debt be issued at the bank level instead of the *BHC* level (see Evanoff and Wall, 2002). They found that the market did account for risk differences and priced risks for both types of sub-debt, although BHC-issued sub-debt yielded a higher risk premium. This differential could reflect the lower priority on the *BHC's* assets in case of insolvency and/or, as argued by others, it could be a result of the safety net being directed at the bank instead of the *BHC*. The important finding is that under a number of alternative specifications the market did appear to impose risk premia on sub-debt issued at the *bank* level.

Jagtiani and Lemieux (2001) examined sub-debt spreads of failed banks during the period prior to their failure and found evidence of strong market discipline. BHC-issued sub-debt spreads significantly rose as early as six quarters prior to the failure of the bank subsidiary. They concluded that sub-debt spreads could potentially be a useful signal in the supervisory process. This aligns well with proposals to consider debt spreads for initiating prompt correction action by supervisors.

Morgan and Stiroh (2000) analyzed whether or not the market was “tough enough” in pricing BHC risk. They evaluated primary issues and tested whether debt spreads reflected the risk of a BHC’s portfolio. They also performed a similar analysis for non-banks to evaluate whether the risk-spread relationship differed between the banking organization and non-banks and whether the market adequately disciplined larger banking organizations. Their concern was that TBTF policies may still result in the market being “too easy” on larger institutions like the LCBOs. They found that the market did price risk exposure at banking organizations -- that is, as their portfolio is shifted into riskier activities, they are forced to pay higher spreads. The risk-spread relationship was nearly identical across the bank and non-bank sectors. However, the risk-spread relationship was weaker for larger banking organizations. They interpret this as evidence that larger banking organizations still benefit from implicit guarantees, although there may be alternative interpretations.

Covitz, Hancock, and Kwast (2000) modeled and empirically estimated the bond issuance decision of banking organizations, and found evidence consistent with the market exerting discipline on the debt *issuance decision*. That is, riskier banks have a higher probability of not issuing new debt: a finding consistent with *ex ante* discipline by debt markets and stressing the need for a mandatory program instead of a voluntary one. They also found the market to be less vigilant during more tranquil periods. They concluded that market discipline could be enhanced by a mandatory sub-debt requirement and that bank supervisors could benefit from monitoring sub-debt spreads.

Finally, Bliss and Flannery (2001) questioned whether the debt markets were able to *influence* the behavior of bank managers. While they found sub-debt spreads were associated with the riskiness of the bank, they did not find evidence consistent with “managerial influence.” That is, management was not found, *ex post*, to respond with portfolio shifts in an attempt to decrease the risk of the firm after debt holders ‘informed’ them that they had become concerned with their risk profile by requiring larger debt spreads.[8] Thus, they questioned whether discipline was being imposed if no signs of influence were found. However, Ashcraft (2006) found that a larger share of subordinated debt in regulatory capital had a positive impact on the future viability of distressed banks in the post-FDICIA period when the ability of the FDIC to absorb the losses of sub-debt holders was significantly restricted. This is consistent with the finding that debt holders reacted differently in the post-FDICIA period and imposed discipline on troubled banks.

Sub-Debt Spreads and Indirect Market Discipline

The potential usefulness of incorporating market information -- sub-debt spreads and changes in sub-debt spreads, equity prices, returns, and volatility; EDF estimated default probabilities, etc. -- into the bank supervisory process has also been documented in the literature.[9] The results overall suggest that market information could be used to improve the predictive accuracy of traditional off-site monitoring models in predicting the future condition of the bank, frequently measured by changes in the CAMEL ratings assigned by regulators. This is not to imply that the market knows more about the condition of banks than do bank supervisors, who have access to extensive private information through their on-site examination process. Rather, it is a realization that financial markets, and the supervision of those markets, are becoming increasingly complex and all possible sources of information should be utilized.

Meyer (1998) argued that the spreads could be used to help the FDIC set more accurate deposit insurance premiums. Evanoff and Wall (2001, 2002) suggest using sub-debt spreads to initiate prompt corrective action by bank supervisors. Using the examiners' overall rating of the banking organization (CAMELS or BOPEC) as the measure of the 'true' riskiness of the organization, they found that debt spreads did as well or better at predicting the riskiness of the

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[8] See Evanoff and Wall (2000b) for a critique of the policy conclusions of Bliss and Flannery. For completeness, there has also been research evaluating the potential for market discipline from sub-debt and other market instruments in non-U.S. markets -- see Sironi (2001, 2003), Hamalainen, Howcroft and Hall (2003) and Baumann, and Nier (2003).

[9] See Seale and Bloecher (2001), Curry, Elmer and Fissel (2003), Krainer and Lopez (2004), Berger, Davies and Flannery (2000), Krishman, Richken and Thomson (2006), Gropp, Vesala and Vulpes (2006), and Gunther, Levonian and Moore (2001).

banking organization than did capital ratios (the measure currently used to initiate prompt corrective action). Hancock and Kwast (2001) find that monitoring of sub-debt markets by bank supervisors could provide useful information, although they questioned whether supervisory actions should be tied directly to this information – due to concerns related to the quality of the sub-debt signal and the potential inconsistency of data on sub-debt spreads across banks.

With a realization that sub-debt spreads may be noisy, below we examine the important determinants of sub-debt spreads. To account for illiquidity, transparency, and disclosure quality, we pay particular attention to those spreads around the period of new debt issues when the market tends to be deeper and more transparent as issuers tend to be more forthcoming in disclosing information. More precisely, we examine differences in the pricing behavior of bank sub-debt during the issuance period relative to other periods and contend that the characteristics of the market surrounding new issues will more closely approximate those that would exist with a fully implemented sub-debt program.

III. The Empirical Model

Our empirical approach relies on the assumption that banks may be less opaque around the time they approach the market for new debt placements. This is likely to be a result of the initial placement process in which banks realize that the issue will be evaluated by credit rating agencies and their financial condition will receive more scrutiny than it typically would on a continual, on-going basis. Thus, banks are likely to be more forthcoming and more willing to provide the market with additional information in order to convince it to accept their new debt issue and to favorably price/rate it [see Covitz and Harrison (2004)]. This is not to imply that the banks attempt to hide information at other times, rather that they simply have a process for new debt issues which generates more information for the markets. Unless some newsworthy event occurs, less information will typically be provided on an on-going basis to the secondary market. This should result in a more informative spread-risk relationship during the issuance period, due to the increased information flow.

To test for the presence of this differential effect, we take a somewhat 'progressive' approach in our analysis. We start with a basic model to describe the risk-spread relationship and progressively account for additional influences including the potential for sample selection bias, year fixed-effects and firm fixed-effects. We then utilize a specification that attempts to account for the marginal impact of risk around the time of new issues. Since there is no obvious preferred model, we estimate a number of alternative specifications. Although initially adding elements to the basic model probably helps capture important influences on the spread relationship, moving to the most sophisticated model may stress the small sample characteristics of our data. Importantly, we will be looking for robustness across the various specifications, particularly with respect to the risk variables.

The Basic Model of the Risk-Spread Relationship

The first step is to specify a model that explains the bank's sub-debt spread. Spreads are expected to be related to macroeconomic conditions, characteristics of the issuing bank, and characteristics of the debt instrument. That is:

$$SPREAD_{i,t} = f(M_i, R_{i,t}, X_{i,t}) \tag{1}$$

where $SPREAD_{it}$ is the difference between the sub-debt yield for bank *i* and the yield of a Treasury security with the same time to maturity at the end of each quarter, M_t is a vector of macroeconomic measures, R_{it} is a vector of the various measures of bank *i*'s risk, and X_{it} is a vector of other firm-specific or security-specific control variables.

Since credit spreads may vary over the business cycle, we capture the influence of general economic and financial market conditions with an array of financial variables. $UNEMP_t$ is the seasonally adjusted national unemployment rate obtained from the Bureau of Labor Statistics Data, and $TBILL\_3M_t$ is the 3-month Treasury bill (secondary market) rate. We also include a binary variable to indicate the current state of economic conditions (*D_EXPAND*), which is equal to one if it is an expansionary period and zero otherwise. This variable is obtained from the business cycle reference measure provided by the National Bureau of Economic Research

(NBER).

To account for risk differences across banks and through time, we include alternative measures of bank risk. Balance sheet risk variables include the percent of non-performing loans to total assets (*NPLOAN*), percent of other real estate owned to total assets (*OREO*), the return on assets (*ROA*), and the market leverage ratio (*MKTLEV*). The variable *MKTLEV* is the ratio of total liabilities (book value) to the combined value of common stock (market value) and preferred stock (book value). This is a proxy of the banking organization's default risk as perceived by the market, since it captures the shift in market price of the bank's common stock relative to the movement of the bank's balance sheet information.[10] As an alternative to the balance sheet risk measures, we include an 'agency' measure of banking organization's credit rating assigned by Standard & Poor's (*SPRATE*). The variable definitions are summarized in Table 1. Table 2 Panel A provides summary statistics of the variables. The cardinalization of the S&P ratings follows the scale used in Ronn and Verma (1987) and Jagtiani, Kaufman, Lemieux (2002), as shown in Table 2 Panel B, where less creditworthy banks (lower alphabetical rating) are converted to a larger numerical rating.

The risk variables *NPLOAN*, *OREO*, *SPRATE*, and *MKTLEV* are expected to be positively correlated with spread. The role of *ROA* is somewhat ambiguous. Higher *ROA* could reflect market power and/or greater efficiency implying a negative expected relationship with *SPREAD*. However, it could also be indicative of greater risk taking implying a positive relationship. We are particularly interested in whether individually or combined the risk measures affect the debt spread. Collinearity between the alternative measures could mask somewhat the individual influence of the variables, so, we will also evaluate the influence of the group of risk measures on sub-debt spreads.

In addition to the risk and macroeconomic variables, we include a number of control

[10] This definition of leverage takes into account the market value of the bank rather than relying purely on book-value accounting information. This definition has been used in Jagtiani, Kaufman, and Lemieux (2002), Jagtiani and Lemieux (2001), Flannery and Sorescu (1996), and Hancock and Kwast (2001). This measure tends to be positively related to the bank's sub-debt spreads, reflecting greater risk at banks with higher market leverage ratios.

variables describing characteristics of the issuing bank and the debt instrument. To allow differences resulting from bank size, we include *ASSETS,* which is measured as the log of bank assets, to control for size. The coefficients of *ASSETS* are expected to be negative as larger banking organizations are likely to be more diversified and better managed, and some may also be perceived by the market as being “too-big-to-fail”. To account for where within the banking organization the debt is issued, the variable *D_BANK* is set equal to one if the observed spreads are associated with sub-debt issued at the bank level, and zero if the sub-debt was issued at the BHC level. Sub-debt spreads may be somewhat narrower when issued at the bank level due to either the bank being a less risky entity than the parent organization or the fact that the FDIC federal guarantee is provided at the bank level. We also account for the bond’s term to maturity since past research has found differences in spreads over the life of the bond. Huang and Huang (2003) find that less than 25 percent of the credit risk-spread is explained by credit risk and that behavior of the credit spreads (which have already accounted for time to maturity along the yield curve) differ at short maturities from that of long maturities. We use a binary variables *TTM_Long* to indicate that the bond has a maturity of five years or longer.[11]

The basic SPREAD specification is:

$$\begin{aligned} SPREAD_{i,t} &= \beta_0 + \beta_1(TBILL\_3M_t) + \beta_2(UNEMP_t) + \beta_3(D\_EXPAND_t) + \\ &\beta_4(D\_BANK_{i,t}) + \beta_5(TTM\_LONG_{i,t}) + \beta_6(ASSETS_{i,t}) + \\ &\beta_7(NPLOAN_{i,t}) + \beta_8(ROA_{i,t}) + \beta_9(OREO_{i,t}) + \beta_{10}(MKTLEV_{i,t}) + \\ &\beta_{11}(SPRATE_{i,t})+) + e_{i,t} \end{aligned} \qquad \text{----- (2)}$$

We divide our observations into two subsamples based on whether the banking organization has recently issued new debt – issuance subsample and non-issuance subsample – and estimate the basic risk-spread model based on equation (2) separately for each of the subsamples. We then compare the estimated coefficients between the two subsamples to evaluate the importance of risk variables in determining sub-debt spreads during the issuance vs. non-issuance period.

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[11] We also considered a continuous measure using the number of quarters until the maturity date. Our

For each observation, a binary variable *D_ISSUE* is equal to one if the bank has issued new debt in the current or previous quarter, and equal to zero otherwise. The issuance subsample consists of observations around new issues only, that is, *D_ISSUE*=1. The non-issuance subsample consists of observations whose *D_ISSUE*=0. Since debt issuance may occur early or late in the quarter, resulting in varying amount of information being distributed to the market, we include the quarter immediately following the issuance quarter in our *D_ISSUE* definition as well to allow for the full distribution of information and transparency to take place. All the relevant information should be in the public domain in the quarter following issuance regardless of when in the previous quarter the actual issuance occurred.

In order to test whether the risk-spread relationship is tighter (stronger market discipline) for the issuance subsample than for the non-issuance subsample, we perform the following analysis. First, we test whether the marginal contribution of the risk variables to the overall measure of goodness-of-fit (R-square) is larger for the issuance subsample than for the non-issuance subsample. Closely-related to this, we test whether the significance and joint-significance of the risk variables are stronger for the issuance subsample than for the non-issuance subsample. We recognize that comparing the adjusted R-square across different data sets needs to be undertaken with care. Since the R-square is a measure of proportion of variation explained by independent variables relative to the total variation, the R-square is thus sensitive to the total variation of the dependent variable – see Kennedy (2003). To the extent that the variation of *SPREAD* is different across the issuance and non-issuance subsamples, it is arguable that the comparison across these subsamples may be distorted in an unknown direction. The summary statistics presented in Table 2, however, indicate that the variance of *SPREAD* is similar in magnitude across the two subsamples, suggesting that our comparison of R-square across issuance and non-issuance subsamples is not inappropriate.

Second, we utilize an alternative approach to compare goodness-of-fit across the issuance and non-issuance subsamples. Specifically, we fit the various model specifications

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findings were less significant, but overall consistent across specifications.

using the entire data set – both issuance and non-issuance observations imposing the same spread relationship across the sample. We then separately calculate the root mean square errors (RMSEs) for the two subsamples, We find that this measure of goodness-of-fit (using RMSEs and changes in RMSEs) behaves in similar fashion as the adjusted R-square. We conclude that our comparison of the adjusted R-square across subsamples is a useful metric for our specific empirical exercise (although it could be inappropriate in other circumstances). The adjusted R-square and RMSEs are reported in the bottom of each table for each model specification.

Finally, we test whether sub-debt spreads respond differently to changes in the risk variables across the two subsamples – i.e. testing the difference in the coefficients of the risk variables between the issuance and non-issuance subsamples. The difference in the risk pricing behavior between the two subsamples may arise from the improved disclosure accuracy and transparency during the period around new issuances. However, regardless of cause, we are most interested in seeing if the response to risk differs across the two subsamples.[12] To put the magnitude of the differences into perspective, we also calculate the Risk-Spread Net Effect, which is a measure of change in *SPREAD* as the balance sheet risk variables change in the direction that increases the bank's risk by one standard deviation. The calculated Risk-Spread Net Effect measures are also reported in the bottom of each table, and they are expected to be larger for the issuance subsample to indicate stronger market discipline during the issuance period.

Extended Models For Risk-spread Relationship:

We then extend the basic risk-spread relationship model to take advantages of the panel structure of our data and to account for possible sample selection bias. The results from our extended model are intended to provide a robustness test for our basic analysis. The intention is not to proof that the extended model better represents the real data generating process than the

12 While we initially casually compare the coefficient on the risk variables, below we will formally test whether or not the differences in coefficients of the risk variables are significant -- see the section called "Single Equation Estimation for the Marginal Effect Around Issuance."

benchmark model, but rather, to make sure that our basic results are robust to plausible extensions.

We extend our benchmark risk-spread model in three ways. First, we add year dummy variables to our basic model in order to better control for any differences in the financial markets and the economic and regulatory environment over the sample period that may not be adequately captured by our macroeconomic variables. Second, we incorporate into our basic risk-spread model the unobserved effect that is unique to each individual banking organization. This bank-specific fixed-effect is intended to control for the banking organization's brand value or name recognition among investors that are time-invariant during our sample period. Finally, we extend our model to address the potential sample selection bias in the Ordinary Least Squares (OLS) estimates. OLS estimates could be bias if certain banks are more likely to issue sub-debt than are others, thus the sub-debt spreads we observe do not include the spreads (risk measures) for banks that decide not to issue. For example, riskier institutions may be less willing to go to the market with new debt issuance out of concern that they will be more harshly disciplined by the bond market – i.e., they must pay a high risk premium. Covitz, Hancock, and Kwast (2000) and Covitz and Harrison (2004) find evidence consistent with the view that issuance is not a random event, but is correlated with banks' risk measures. We apply Heckman's two-stage least square estimation, developed by Heckman (1979) and Greene (1981), to correct for this potential bias.

Heckman proposes that a bivariate model be used to explicitly estimate the bank's decision to issue sub-debt. Thus, we first estimate a Probit model for the issuance decision – whether or not to issue sub-debt. The model of the issuance decision includes a variety of variables that are likely to be correlated with the banks' issuance decision. Based on the estimated Probit model, we then calculate the inverse-Mill's ratio for each observation. The Inverse Mill's ratio measures the expected value of the idiosyncratic component in the issuance model given $D\_Issue_{i,t}$. This factor is then incorporated into the risk-spread relationship to generate unbiased and consistent parameter estimates.[13]

In our Probit model for the sub-debt issuance decision, we include factors that are related to current market conditions, regulatory capital need, and bank-specific characteristics. The model is presented in equation (3) below, where the dependent variable, *D_Issue*, is as defined before:

$$\begin{aligned} D\_Issue_{i,t} &= \alpha_0 + \alpha_1(UNEMP_t) + \alpha_2(TBILL\_3M_t) + \alpha_3(D\_EXPAND_t) + \\ &\alpha_4(ASSETS_{i,t}) + \alpha_5(MKTLEV_{i,t}) + \alpha_6(NPLOAN_{i,t}) + \alpha_7(OREO_{i,t}) + \\ &\alpha_8(ROA_{i,t}) + \alpha_9(CAPNEED_{i,t}) + \alpha_{10}(PE\_CAPNEED_{i,t}) + \\ &\alpha_{11}(PAST\_Issue_{i,t}) + \alpha_{12}(SPRATE_{i,t}) + \mu_{i,t} \end{aligned} \quad \text{------ (3)}$$

The macroeconomic and risk variables have been previously defined. Additional factors thought to influence the issuance decision include a binary variable *PAST_Issue* indicating whether the firm has issued any publicly traded securities in the previous six to twelve month period.[14] The indicator variable *CAPNEED* is a measure of the bank's need for additional capitalization -- a binary variable equal to one if the capital rating in the regulators CAMEL score (the 'C' component of the CAMEL) is unsatisfactory (a rating of 3, 4, or 5) and zero otherwise. Banks with a 3-rated or worse 'C' component are likely to be pressured to raise their capital ratios by issuing equity or sub-debt. The variable *PE_CAPNEED* is an interactive term of the price-earnings ratio and the *CAPNEED* indicator variable. An undercapitalized bank's decision whether to issue new sub-debt or equity to meet its funding need is likely affected by the relative market price (over-valued or under-valued) of their shares when additional capital is needed. The price-earnings (PE) ratio is used to proxy for the over- or under-valuation of the stock. The coefficient of *PE_CAPNEED* is therefore expected to be negative if banks tend to issue equity rather than

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[13] For observations with $D\_Issue_{i,t}$ =1, this expected value (E[$\mu_{i,t}$ | $D\_Issue_{i,t}$ =1]) is given by Φ(-$D\_Issue_{i,t}$ _hat) / (1– Ω(-$D\_Issue_{i,t}$ _hat) where $D\_Issue_{i,t}$ _hat is the predicted probability that $D\_Issue_{i,t}$ =1, and Φ(.) and Ω(.) are, respectively, the density function and the cumulative distribution of a standard normal random variable. For observations with $D\_Issue_{i,t}$ =0, this expected value (E[$\mu_{i,t}$ | $D\_Issue_{i,t}$ =0]) is given by Φ(-$D\_Issue_{i,t}$ _hat) / (Ω(-$D\_Issue_{i,t}$ _hat). See Lee (1978) for more detailed discussion.

[14] We also included the ratio of insured deposits to total liabilities in the model. Previous studies found that riskier banks tend to rely more on insured deposits as a subsidized funding source -- see Billet, Garfinkel and O'Neal (1998) and Jagtiani, Kaufman and Lemieux (2002). This variable is not included in the final

sub-debt when their equities are over-priced.

In the spirit of providing robust evidence, we estimate this first-stage Probit model in two ways. First, we estimate the model using the standard Heckman model where all the observations in our sample are included. The observation-specific inverse Mill's ratio obtained from this procedure is denoted as λ_1. While this is the standard approach for estimating Heckman's first-stage Probit model, the model was not originally designed for use with a panel dataset. Our alternative method specifies a separate first-stage Probit model for each individual year to allow the issuance factor (the inverse Mill's ratio) to be estimated separately through time. Berger, Kyle, and Scalise (2001) employ this approach in their estimation of the inverse Mill's ratio as a way to generate more accurate estimates and to take advantage of the panel structure of the data. We follow that approach and denote the observation-specific inverse Mill's ratio obtained in this alternative method as λ_2. The bank- and time-specific fixed effects and the estimated inverse Mill's ratios are then incorporated to produce our extended models of the risk-spread specification.

$$\begin{aligned} SPREAD_{i,t} &= \beta_0 + \beta_1(TBILL\_3M_t) + \beta_2(UNEMP_t) + \beta_3(D\_EXPAND_t) + \\ &\beta_4(D\_BANK_{i,t}) + \beta_5(TTM\_LONG_{i,t}) + \beta_6(ASSETS_{i,t}) + \\ &\beta_7(NPLOAN_{i,t}) + \beta_8(ROA_{i,t}) + \beta_9(OREO_{i,t}) + \beta_{10}(MKTLEV_{i,t}) + \\ &\beta_{11}(SPRATE_{i,t}) + \beta_{12}\lambda_{i,t} + \beta_{13}D_i + \beta_{14}T_t + e_{i,t} \end{aligned} \qquad \text{-------} \quad (4)$$

where D_i is the fixed-effect for bank i; and T_t is the fixed-effect for year t.

We then conduct similar analysis with this extended model as we did with the basic model---equation (2). Specifically, we compare the marginal explanatory power of risk measures, the joint significance of risk variables, and the robustness of risk variables across different model specifications and across the subsamples – issuing and non-issuing observations.

Single Equation Estimation for the Marginal Effect Around Issuance:

Our analysis so for has been perform separately for each of the subsamples. Our prior is

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model since insured deposit data is only reported annually and it did not add significant explanatory value.

that there will be additional disciplining around the time of new debt placements, when the market will be "more aware" of the bank's financial condition and the overall riskiness of the bank. We have accounted for this by separately estimating equations (2) and (4) for subsets of observations depending on whether or not new debt issues occurred. In this section, we combine the issuance and non-issuance subsamples and explicitly estimate the marginal impact surrounding periods when issuance occurred. With this alternative specification, we can test whether the responsiveness of the risk measures is significantly different across the two groups of banks by interactively associating the various risk-characteristics, as reflected in equations (5). The significance of the coefficients of these interactive risk measures would suggest whether the risk-spread relationship (or sensitivity) is significantly different across the two subsamples.

$$
\begin{aligned}
&SPREAD_{i,t} = \beta_0 + \beta_1(TBILL\_3M_t) + \beta_2(UNEMP_t) + \beta_3(D\_EXPAND_t) + \\
&\beta_4(D\_BANK_{i,t}) + \beta_5(TTM\_LONG_{i,t}) + \beta_6(ASSETS_{i,t}) + \\
&(\beta_7 + \delta_7 D\_Issue_{i,t})(NPLOAN_{i,t}) + (\beta_8 + \delta_8 D\_Issue_{i,t})(ROA_{i,t}) + \\
&(\beta_9 + \delta_9 D\_Issue_{i,t})(OREO_{i,t}) + (\beta_{10} + \delta_{10} D\_Issue_{i,t})(MKTLEV_{i,t}) + \\
&(\beta_{11} + \delta_{11} D\_Issue_{i,t})(SPRATE_{i,t}) + \beta_{12}\lambda_{i,t} + \beta_{13}D_i + \beta_{14}T_i + e_{i,t}
\end{aligned} \qquad (5)
$$

IV. Data Sources and Empirical Results

The Data

It has been difficult to analyze and compare sub-debt spreads across banks in a time-series analysis because of difficulties involved in finding homogeneous sub-debt issues in the market. In addition to differing with respect to specific characteristics (features, options, maturities, etc.), a meaningful comparison of sub-debt spreads across banks may also be difficult because of thin trading of some issues.[15] Our sample banks and BHCs are derived from the largest 100 U.S. commercial banks and their parent BHCs as of year-end 1990. For these banking organizations, we collected detailed information on outstanding bonds from Bloomberg Data Services. We selected one representative subordinated bond for each bank and one

[15] Bianchi, Hancock, and Kawano (2003) suggest that illiquid bonds with less frequent trading activities are priced relatively poorly, and that the uncertainty about an illiquid bond's price rises under volatile

representative subordinated bond for each BHC at each point of time. To be included in the sample, the selected debt securities had to meet the following criteria: (1) be publicly traded in order to be able to trace historical prices and yields, (2) be in issues of at least $100 million, (3) be U.S. dollar denominated and issued and traded in the U.S. capital markets, (4) be rated by S&P and/or Moody's, and (5) be straight bonds with no callable, putable, convertible, or other option features. The sample is restricted to option-free bonds to obtain a more homogeneous group of bonds and to avoid excessive noise introduced by the models used for computing option adjusted spreads, which vary substantially among market participants. The final sample includes subordinated bond issues for 19 banks and 39 BHCs for the period 1990-1999.

We collected secondary market prices of securities outstanding at quarter-end over this time period.[16] Bond yields were computed from the observed prices of the bonds, and information on the accounting risk characteristics of the issuing banks was obtained from the Report of Condition and Income (Call Report) for banks and Federal Reserve Y-9 and Y-9LP Reports for BHCs. Information on *CAPNEED* was generated from confidential bank regulator's CAMEL and BOPEC ratings. Bond ratings were obtained from Bloomberg or directly from S&P.

Results For the Basic Risk-Spread Model

Table 3 presents the results from estimation of our basic model of sub-debt spreads as presented in equation (2). Observations for banks that recently issued new debt are analyzed separately and the results for this group are included in Panel A. Results using observations during periods when new debt was not issued are presented in Panel B. We include four alternative specifications for each subsample. Column (1) excludes the risk measures to provide a basis from which we are able to calculate the marginal contribution from including measures of bank risk. As stated earlier, previous studies found that prior to the early 1990s, debt spreads

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market conditions.

[16] Bloomberg reports BGN bond prices, which are a volume-weighted average of transaction prices in each day. When securities are not traded, quoted prices (by a number of pricing providers) are reported. Reported quoted prices are weighted average based on at least two price sources (that are within a 'tight' range).

were not closely related to risk characteristics. However, studies also suggest that this changed in the early part of our sample period following the FDICIA. Column (2) presents results for our basic model incorporating balance sheet risk measures; Column (3) presents results using the agency risk measure; and results incorporating both sets of risk measures are included in Column (4).

Generally, the results in Panel A of Table 2 suggest that macroeconomic conditions, term to maturity, and the bank's risk characteristics are important determinants of sub-debt spreads. This holds for each of the four specifications. Spreads are positively related to the level of short-term risk-free interest rates (*TBILL_3M*) and the unemployment rate (*UNEMPLOY*). Similarly, sub-debt spreads tend to be smaller during expansionary periods (*D_EXPAND*). The spread is also found to be higher for securities with longer maturities (*TTM_Long*), but smaller for sub-debt that was issued at the bank level (*D_BANK*) compared to those issued at the BHC level. Again, these results are overall consistent for each of the four specifications.

In terms of the role of risk in determining sub-debt spreads, the results are again relatively consistent for observations around new debt issues across the four specifications. Balance sheet measures found to significantly influence the spread include the ratio of non-performing loans (*NPLOAN*) and profitability as measured by returns on assets (*ROA*). Banks with larger non-performing loans and lower profits are subject to larger sub-debt spreads (risk premiums). The coefficient of *OREO* becomes significant when *SPRATE* is also included (column 4) but with a negative (unexpected) sign. The coefficients on the market leverage ratio (*MKTLEV*) are positive (as expected) but not statistically significant. The alternative agency risk proxy (*SPRATE*) is positively related to the credit spread as expected; either when entered separately or when combined with the balance sheet measures.

From Table 3 Panel B, the results found for the risk variables using the non-issuing observations are neither as strong nor as consistent as those found with the issuance subsample. Of the included balance sheet risk measures, only *OREO* is significant with the expected sign, and the significance of that measure goes away when *SPRATE* is also included (column 4).

Unlike in the issuance subsample, *NPLN_NA* and *ROA* are not significant for the non-issuance subsample. *MKTLEV* has the expected sign, but is also not significant, as in the issuance subsample. The agency risk measure (*SPRATE*) is significant with a similar impact to that found with the issuing subsample in terms of the magnitude of coefficients.

More generally, the overall results from Table 3 indicate that the goodness-of-fit for observations around a new debt issue, versus observations unrelated to new issues, is much better with R-square values being higher with each of the four specifications. For the most comprehensive specification, over 67 per cent of the variation is explained by the explanatory variables while only 52 percent is explained during periods when a bank did not approach the market to issue debt. Also consistent with our priors, the additional explanatory power added by including the risk measures is greater for the observations around new debt issues. Using the balance sheet risk measures, the R-square increases from 55 percent to 65 percent around new debt issues, and only increases from 41 percent to 47 percent for non-issuing observations. As expected, the differential in explanatory power across the two panels is small when using the credit agency risk measure, since the credit agency's ratings are quite transparent to the public at all time (whether or not around new debt issuance) and they are usually quite sluggish in changing. Nevertheless, the R-square from specifications that include *SPRATE* are also higher at 67 percent for the issuance subsample compared to 52 percent for the non-issuance subsample.

We have demonstrated, so far, that the goodness-of-fit as measured by R-Square is better for the issuance compared to that of the non-issuance sub-group. Appendix I shows that the R-square using the primary market spreads (spreads observed during the initial public offerings) is even higher – up to 72 percent compared to 67 percent for the issuance subsample and 52 percent for the non-issuing subsample using spreads observed in the secondary market. The explanatory power of balance sheet risk measures is also larger for primary market spreads – with 35 percent increase in R-Square compared to the model specification without risk measures. The results suggest that the risk-spread relationship seems to be tighter in deeper markets with increased liquidity and transparency.

As an alternative to the R-square and marginal R-square measures to gauge the goodness-of-fit across specifications and data sets, we utilize an alternative approach using the root mean square errors (RMSE). Using the combined data set– issuance and non-issuance subsamples – we estimate the risk-spread relationship and then use the estimates to calculate the RMSE for each subsample. The calculated RMSEs for each model specification are reported in the bottom of Panels A and B of Table 3 as an alternative measure of goodness-of-fit. As expected, when additional risk variables are included in the model, the goodness-of-fit improves and we observe a reduction in the RMSEs. The calculated reduction in RMSE is intended to capture the increased explanatory power of the additional risk variables. Comparing the magnitude of RMSE reduction across the two subsamples – issuance vs. non-issuance – indicates how much the additional risk variable has helped to improve the goodness-of-fit. From the RMSEs in the bottom of each column in Table 3, we find that, overall, the RMSE is smaller for the issuance subsample. In addition, the reduction in RMSE when the balance sheet risk factors are included in the model is also larger for the issuance subsample. Our results, again, indicate a tighter risk-spread relationship around the issuance period – thus, stronger market discipline around debt issuance.

Given the potential correlation between the risk measures, the variance of the individual risk measures can be quite large and we may be underestimating the true influence of risk in the above discussion -- see Covitz, Hancock and Kwast (2004, page 9) and Flannery and Sorescu (1996, page 1361). This may explain some of the changes in the sign on coefficients in Table 2; e.g., the coefficient on *OREO* in each specification. Thus, we also test for the overall influence of the risk variables by testing their joint significance in affecting spreads. Results of the F-tests evaluating the combined impact of the risk variables are included at the bottom of Table 3. In all specifications, for both panels, the null hypothesis that the joint effect of the alternative risk measures is equal to zero is rejected, with the calculated F-statistics being significantly greater for the issuance subsample.

Finally, we evaluated the joint impact of the risk variables for each subsample by comparing the calculated value of the spread at the subsample mean of the explanatory variables to that where we increased the risk of each risk measure above the sample mean by one standard deviation. Table 3 shows that, for each subsample, the spread increased as a result of increasing the risk measures, but the increase was significantly greater for the issuance observations than for the non-issuance subsample. From Column (2) of Panel A and Panel B, the spreads increase by 35.4 basis points for the issuance subsample compared to 29.4 basis points for the non-issuance subsample. Similarly, from Column (4) Panel A and Panel B, the spreads increase by 14.9 basis points and 9.0 basis points for the issuance and non-issuance observations, respectively, when the overall risk measures increase by one standard deviation. This finding is consistent with an argument that investors do seem to incorporate risk differences into debt pricing and appear to do so more effectively around new debt issuance period when the market is deeper and more transparent.

Thus, summarizing results for our basic risk-spread model (Table 3), risk measures do seem to be correlated with debt spreads and to add to the explanatory power of the *SPREAD* relationship for each subsample. The explanatory power of the relationship is stronger for banks that had a new debt issue within the previous six months (Panel A) and the increase in explanatory power from including the risk measures is greater for those banks with recent debt issues. We interpret these findings to be consistent with there being a closer risk-spread relationship around new debt issuance and consistent with this being related to deeper markets.

Results for the Extended Risk-Spread Models

In the following analysis, we include the year fixed-effects, firm fixed-effect and account for potential sample selection bias. The results of the Probit analysis of issuance decision, based on equation (3) and presented in Appendix II, indicate that larger banking organizations and those banks in need of additional capital are more likely to issue sub-debt as the coefficients of *ASSETS* and *CAPNEED* are significantly positive. In addition, banks that issued publicly traded debt in the last 6-12 months are also more likely to issue more debt, as the coefficients of *D_PASTISSUE* are significantly positive. The two important risk factors that impact the bank's issuance decision seem to be *MKTLEV* and *OREO* – less risky banks with smaller market leverage ratios and smaller *OREO* are more likely to issue new debt. The other risk factors, including the agency's credit rating, seem to be unimportant in the banks' issuance decision. The resulting estimated inverse Mill's ratio (λ_1 and λ_2) from the Probit estimates are incorporated into the analysis in the next step.

Results from incorporating time and firm fixed-effects and the adjustment for the potential sample selection bias (the inverse Mill's ratio) are presented in Table 4 -- the coefficients for the year and firm fixed-effects are not reported. Again, the results for observations around new debt issues are presented in Panel A, and those for non-issuance observations are in Panel B. For the issuance subsample, by accounting for these additional influences, some of the economic variables (*TBILL_3M* and *UNEMPLOY*) have turned insignificant. However, many of the previous relationships continue to hold up. Profitability (*ROA*) and nonperforming loans (*NPLN_NA*) continue to be related to spreads as expected. Similarly the agency risk measure (*SPRATE*) continues to have the expected relationship with spreads in all specifications whether entered by itself, or included with balance sheet risk measures. Finally, the results do not tend to differ significantly when alternative measures of the Inverse Mills Ratio (λ_1 and λ_2) are employed and the sign and significance of the λ_1 and λ_2 are similar across the alternative specifications. From Table 4 Panel B, for the non-issuance subsample, the estimated coefficients for *NPLN_NA*, *ROA*, and *MKTLEV* continue to be mostly insignificant and *OREO* continues to positively affect the spread. The agency risk measure (*SPRATE*) also continues to come in significantly positive in all specifications. Overall, the results are relatively robust to the extension of the model, and again, the risk-spread relationship continues to be different between the two-subsamples – with a stronger risk-spread relationship for the issuing sample.

Perhaps more so than before, with these more complex specifications, we have significant potential for correlation between the risk measures, which could make the variance of the individual risk measures quite large. Again, this could result in an understating of the true influence of risk. We, therefore, test for the joint significance of the risk variables in affecting sub-debt spreads. In all specifications, for each Panel of results, results for the F-tests suggest that there is a significant joint influence from the risk variables on sub-debt spreads. The reported F-statistics are also consistently higher across the alternative specifications for the subsample of banks that recently had new debt issues (Panel A), although all exceed the critical values at standard levels of significance. In addition, consistent with the earlier reported results, we find evidence that the explanatory power of the risk-spread relationship is significantly greater for banks that recently had new debt issues. Across the alternative specifications, the R-square in Panel A ranges from 76-82 percent. In no specification in Panel B does the explanatory power reach similar levels with R-squares ranging from 65-74 percent.

As in Table 3, we again evaluate the economic impact of the risk variables on spreads for each subsample by comparing the spread at the sample mean when each risk measure is increased by one standard deviation. From Columns (1) and (4) of Panel A and Panel B, the spreads increase by about 37 basis points for the issuance subsample compared to 8-18 basis points for the non-issuance subsample, when the balance sheet risk measures are increased by one standard deviation. Similarly, from Columns (3) and (6) of Panel A and Panel B, the spreads increase by 15-19 basis points for the issuance observations compared to 5 basis points or lower for the non-issuance observations, when all risk measures are increased by one standard deviation. Consistent with the earlier results, Table 4 also shows that the increase in spread is significantly greater for the issuance than for the non-issuance subsample as a result of increasing risk. Again, this is consistent with an argument that investors appear to price the risk more effectively (stronger market discipline) around new debt issuance period.

Overall, the results from our extended risk-spread models tend to confirm those from the basic model. Risk measures do seem to be correlated with sub-debt spreads and add to the explanatory power of the *SPREAD* relationship for each subsample. The explanatory power of the relationship is stronger for banks that had a new debt issue (Panel A) and the increase in explanatory power from including the risk measures is also greater for these banks with recent debt issues. We interpret these findings to be consistent with those of our basic model and consistent with a closer risk-spread relationship around new debt issuances. We posit that this closer relationship is a result of deeper markets.

Results for the Single Equation Estimates

In this section, we extend the model to include all observations (with and without new debt issuance) in a single relationship. Including the issuance indicator variable and the interactive terms allows us to test whether the responsiveness of risk measures is significantly different, in a statistical sense, across the issuance and non-issuance samples. Table 5 reports the results from the analysis that evaluates the marginal impact of risk factors around new debt issues, based on equation (5). The significance of the economic variables in the spread model is similar to those reported in Table 4, where *TBILL_3M* and *D_EXPAND* are significant. Again, the spreads are generally smaller for sub-debt that is issued at the bank level (rather than the BHC level) and larger for debt with longer time to maturity.

With some exceptions, the role of the risk measures is in line with expectations; and the exceptions are likely related to the collinearity between risk measures including the interactive terms. Ignoring the marginal effect surrounding new debt issues, the coefficient on returns on assets (*ROA*), nonperforming loans (*NPLN_NA*), and market leverage (*MKTLEV*) are generally insignificant, while *OREO* is significantly positive. The coefficients of the interactive terms (between the issuance indicator and the risk measures) are mostly significant. The coefficients on *D*ROA* are consistently significant, while the coefficients of *D*NPLOAN* and *D*OREO* are generally significant, but the significance sometimes disappears in the specifications that also include credit agency rating (*SPRATE* and *D*SPRATE*). The results overall demonstrate significant differences in the risk pricing (risk premiums) imposed by the market – for the issuance vs. non-issuance subsamples. This supports our earlier findings that the risk-spread relationship is different around new-debt issuance.

Additionally, we test for the significance of the marginal effect of issuance and the combined risk measures around the time of new debt issues. The F-statistics included at the bottom of Table 5 test whether the coefficients of the interactive terms are jointly zero. F-test (1) tests whether the coefficients on *D*NPLOAN, D*ROA, D*OREO*, and *D*MKTLEV* are jointly zero, while the hypothesis for F-test (2) also include the coefficient of *D*SPRATE*. The reported F-test statistics indicate that a hypothesis that the issuance's marginal impact of the risk measures is jointly zero is rejected at standard levels of significance for three of the four specifications that include balance sheet risk measures. The results indicate that the difference in the risk pricing behavior between the two regimes (issuance vs. non-issuance periods) is statistically significant. This is consistent with our earlier finding of tighter market discipline for the issuance subsample.

The calculated RMSE reported in the bottom of Table 5 also indicates better goodness-of-fit for the issuance subsample and stronger risk-spread relationship for the issuance group. Columns (1) and (4) of Table 5 shows the reduction in RMSE from the specification that include only control factors (no bank-specific risk factors). The RMSE was reduced by 1.8-3.0 for the issuance observations compared to only 0.8-1.4 for the non-issuance observations. This larger reduction in RMSE as risk variables are added to the model specifications for the issuance subsample indicates better goodness-of-fit, thus stronger market discipline during the debt issuance period. Similarly, the increase in spreads as risk measures are increased by one standard deviation is calculated for the issuance and non-issuance observations. The *difference* between the two Risk-Spread Net Effect measures is reported in the bottom of Table 5. The consistently positive differences demonstrate a larger change in *SPREAD* (i.e. spreads being more sensitive to risk) for the issuance subsample.

In summary, we find that accounting for additional control variables and using more complex specifications to describe the *SPREAD* model results in deterioration in the significance of some of the control variables. Similarly we find some inconsistencies in evaluating the impact of some of the risk measures across individual specifications. However, in general, we find results that closely align with our priors. In each alternative specification, a test of the joint impact of risk variables indicates that sub-debt spreads are related to the risk of the banks. This satisfies a precondition required for introducing a mandatory sub-debt program for bank regulatory capital. Similarly, we find that the inclusion of risk measures adds to the explanatory power of the risk-spread relationship and that the explanatory power is strongest for banks that recently had issued new debt. Finally, estimation of our most complex specification indicates that the marginal impact of the risk measures is generally, with some inconsistencies, in line with there being a closer relationship between bank risk and sub-debt spreads around new debt issues. Thus, the risk-spread relationship appears to be different during the new issuance periods. This is consistent with our contention that market discipline in the U.S. banking industry could be enhanced if a mandatory sub-debt program were in place and banks were required to regularly approach the market. The riskier banks would not be allowed to avoid coming to the market and avoid the associated discipline, and high quality banks would find it in their self interest to be transparent and make their quality known in the new, deeper and more complete market.

V. Conclusions and Policy Implications

There have recently been a number of proposals to increase the role of subordinated debt in the bank capital requirement in an attempt to increase the role of market discipline on large and complex banking organizations (LCBOs). There has also been a growing consensus that bank risk could be more effectively regulated if market information and market discipline were more fully incorporated into the bank supervisory process. Effective market discipline will enhance the quality of market signals which can be used by bank supervisors for on-site as well as off-site monitoring efforts to identify problem institutions. This could help regulators more efficiently allocate supervisory resources.

Previous studies have found that sub-debt markets do differentiate between banks with different risk profiles. However, these studies have evaluated the potential usefulness of sub-debt in an environment that most likely is very different from the one that will characterize a fully implemented sub-debt program. With a sub-debt program, the market will likely become deeper as issuance will be more frequent, debt will be viewed as a more viable means to raise capital, more attention will be paid to individual bank debt yields, bond dealers will be less reluctant to publicly disclose more details on debt transactions, and generally, the market will be more closely followed and sub-debt signals will be more informative. Fundamentally, banks will respond to the new regulation and optimize within the new regulatory framework with constraints that may be very different from those that existed before the reform.

In order to get an indication of the potential differences between the current and potential sub-debt markets, we evaluate the risk-spread relationship by taking into consideration the enhanced market transparency surrounding new debt issues. Our empirical results generate evidence consistent with the existence of market discipline in the sub-debt market, and with the degree of market discipline being stronger (a tighter risk-spread relationship) during the period around new debt issuance. We attribute this to greater liquidity and transparency. Our overall results support the argument that the degree of market discipline in the U.S. banking industry would likely be enhanced by requiring banks to maintain part of their regulatory capital requirement in the form sub-debt, and to require banks to 'come-to-the-market' at regular intervals with new debt issues regardless of their current financial condition.

A common argument given for not going forward with such a program is that the characteristics of the market are such that the signal may be too noisy to use for public policy. That is, sub-debt markets are too thin, and instrument characteristics are too heterogeneous. However, as explained earlier, once a program is initiated, the markets will become deeper and, if properly implemented, the instruments will become much more homogeneous. What we have tried to show in the current analysis is that even in today's environment, the sub-debt market seems to operate more effectively during periods that more closely resemble the state of the world that would exist with a fully implemented sub-debt program. With a fully implemented program, sub-debt markets would likely become even deeper and more fluid than that seen around new issues in today's markets, making our estimates of increased market discipline a lower bound of the potential for such a program.

REFERENCES

Allen, L., J. Jagtiani, and J. Moser, 2001. "Further Evidence on the Information Content of Bank Examination Ratings: A Study of BHC-to-FHC Conversion Applications." Journal of Financial Services Research 20, 213-232.

Ashcraft, A. B. "Does the Market Discipline Banks? New Evidence from the Regulatory Capital Mix." Federal Reserve Bank of New York Staff Reports # 244, March.

Bank for International Settlement, 1999. A New Capital Adequacy Framework. Consultative Paper Issued by the Basel Committee on Banking Supervision, June.

Baumann, U., and E. Nier, 2003. "Market Discipline and Financial Stability: Some Empirical Evidence." Bank of England Financial Stability Review 13, 134 - 41.

Benink, H. A., and R. H. Schmidt, 2000. "Agenda for Banking in Europe." in Bank Fragility and Regulation: Evidence From Different Countries and Different Times, George G. Kaufman, editor. JAI Press: Greenwich, 25-52.

Berger, A., M. Kyle, J. Scalise, 2001. "Did U.S. Bank Supervisors Get Tougher During the Credit Crunch? Did They Get Easier During the Banking boom? Did It Matter to Bank Lending?" in Prudential Supervision: What Works and What Doesn't, F.S. Mishkin, editor. National Bureau of Economic Research, University of Chicago Press: Chicago, 300-357.

Berger, A., S. Davies, and M. Flannery, 2000. "Comparing Market and Regulatory Assessments of Bank Performance: Who knows what, when?" Journal of Money, Credit and Banking 32, 641-667.

Billet, M., J. Garfinkel, and E. O'Neal, 1998. "The Cost of Market Versus Regulatory Discipline in Banking," Journal of Financial Economics 48, 333-353.

Birchler, U. W., and D. Hancock, 2004. "What Does the Yield on Subordinated Bank Debt Measure?" Finance and Economics Discussion Series, Board of Governors of the Federal Reserve System, Number 2004-19.

Bliss, R., 2001. "Market Discipline and Subordinated Debt: A Review of Some Salient Issues," (Federal Reserve Bank of Chicago) Economic Perspectives 25, 24-45.

Bliss, R. and M. Flannery, 2001. "Market Discipline in the Governance of U.S. Bank Holding Companies: Monitoring vs. Influencing." In Frederic S. Mishkin, (Ed.) Prudential Supervision: What Works and What Doesn't? University of Chicago Press, 107-143.

Board of Governors of the Federal Reserve System and Secretary of the U.S. Department of the Treasury, 2000. "The Feasibility and Desirability of Mandatory Subordinated Debt," Report submitted to Congress Pursuant to Section 108 of the Gramm-Leach-Bliley Act of 1999.

Brewer, E. and J. Jagtiani, 2007. "How Much Would Banks Be Willing To Pay To Become Too-Big-To-Fail and To Capture Other Benefits?" Federal Reserve Bank of Kansas City, Working Paper, June.

Collin-Dufresne, P., R. Goldstein, and J. S. Martin, 2001. "The Determinants of Credit Risk-spread Changes." Journal of Finance 56, 2177-2207.

Calomiris, C. W., 1997. The Postmodern Bank Safety Net: Lessons from Developed and Developing Countries, American Enterprise Institute for Public Policy Research, Washington.

Calomiris, C. W., 1998. Blueprints for a New Global Financial Architecture. September 23, American Enterprise Institute, Washington.

Covitz, D., D. Hancock, and M. Kwast, 2000. "Market Discipline, Banking Organizations and Subordinated Debt." Paper presented at the 2000 Global Finance Association Meetings, (April 21).

Covitz, D., D. Hancock, and M. Kwast, 2004. "A Reconsideration of the Risk Sensitivity of U.S. Banking Organization Subordinated Debt Spreads: A Sample Selection Approach." Economic Policy Review, Federal Reserve Bank of New York 10, 73-92.

Covitz, D., and P. Harrison, 2004. "Do Banks Time Bond Issuance to Trigger Disclosure, Due Diligence, and Investor Scrutiny?" Journal of Financial Intermediation 13, 299-323.

Curry, T., P.J. Elmer, and G.S. Fissel, 2003. "Using Market Information to Help Identify Distresses Institutions: A Regulatory Perspective." FDIC Banking Review 15, 1-16.

DeYoung, R., M. Flannery, W. Lang, and S. Sorescu, 2001. "The Information Content of Bank Exam Ratings and Subordinated Debt Prices," Journal of Money, Credit, and Banking 33, 900-925.

Evanoff, D. and L. Wall, 2000a. "SND as Bank Capital: A Proposal for Regulatory Reform." Federal Reserve Bank of Chicago Economic Perspectives 24, 40-53.

Evanoff, D. and L. Wall, 2000b. "Subordinated Debt and Bank Capital Reform." in Research in Financial Services: Private and Public Policy. G.Kaufman editor, JAI Press,

Evanoff, D. and L. Wall, 2001. "Sub-debt Yield Spreads as Bank Risk Measures." Journal of Financial Services Research 20, 121-45.

Evanoff, D. and L. Wall, 2002. "Measures of the Riskiness of Banking Organizations: Subordinated Debt Yields, Risk-Based Capital, and Examination Ratings." Journal of Banking and Finance 26, 989-1009.

Ferguson, R.W. Jr., 1999. "Evolution of Financial Institutions and Markets: Private and Policy Implications." Speech presented at New York University, February 25.

Flannery, M. and S. Sorescu, 1996. "Evidence of bank market discipline in subordinated debenture yields: 1983 – 1991." The Journal of Finance 51, 1347-77.

Greene, W.H., 1993. Econometric Analysis. New York: MacMillan Publishing Company.

Greene, W.H., 1981. "Sample Selection Bias as a Specification Error: Comment." Econometrica 49, 795-798.

Greenspan , A., 2000. "Banking Supervision," Speech before the American Bankers Association, Washington, D.C. September 18.

Gropp, R., J. Vesala, and G. Vulpes, 2006. "Equity and Bond Market Signals as Leading Indicators of Bank Fragility" Journal of Money, Credit, and Banking 38, 399-428.

Gunther, J., M. Levonian, and R. Moore, 2001. "Can the Stock Market Tell Bank Supervisors Anything They Don't Already Know?" Federal Reserve Bank of Dallas Economic Review, 2-9.

Hamalainen, P., J. B. Howcroft, and M. Hall, 2003. "A Mandatory Subordinated Debt Policy for the UK? Evidence from the Issuance Activity of Banks and Building Societies," Loughborough University Banking Centre Research Paper #163/03, March.

Hancock, D. and M. Kwast, 2001. "Using Subordinated Debt to Monitor Bank Holding Companies: Is it feasible?" Journal of Financial Services Research 20, 147-87.

Heckman, J., 1979. "Sample Selection Bias as a Specification Error." Econometrica 47, 153-61.

Huang, J., and M. Huang, 2003. "How much of the Corporate Treasury Yield Spread is Due to Credit Risk?" Working Paper Series, Stanford University.

Jagtiani, J., G. Kaufman, and C. Lemieux, 2002. "The Impact of Credit Risk on Bank and Bank Holding Company Bond Yields: Evidence from the Post-FDICIA Period." Journal of Financial Research 25, 559-575.

Jagtiani, J. and C. Lemieux, 2001. "Market Discipline Prior to Bank Failure." Journal of Economics and Business 53, 313-324.

Jarrow, R., S. Turnbull and F. Yu, 2001. "Default Risk and Diversification: Theory and Applications." Working Paper Series, University of California, Irvine.

Kane, E., 2000. "Incentives for Banking Megamergers: What Motives Might Regulators Infer from Event-Study Evidence?" Journal of Money, Credit, and Banking 32, 671-701.

Kennedy, P., 2003. A Guide to Econometrics (5th Edition), Oxford, Blackwell Publishing.

King, T.D. and K. Khang, 2002. "On the Cross-Sectional and Time Series Relation Between Firm Characteristics and Corporate Bond Yield Spreads." Working Paper, University of Wisconsin–Milwaukee.

Krainer, J. and J. Lopez, 2004. "Incorporating Equity Market Information into Supervisory Monitoring Models." Journal of Money, Credit, and Banking 36, 1043-1067.

Krishman, C.N.V, P.H. Ritchken, and J.B. Thomson, 2006. "On Credit-Spread Slopes and Predicting Bank Risk" Journal of Money, Credit, and Banking 38, 1545-1574.

Kwast, M., D. Covitz, D. Hancock, J. Houpt, D. Adkins, N. Barger, B. Bouchard, J. Connolly, T. Brady, W. English, D. Evanoff, and L. Wall, 1999. "Using Sub-debt as an Instrument of Market Discipline." Report of a study group on subordinated notes and debentures, Board of Governors of the Federal Reserve System, Staff Study, No. 172.

Maddala, G.S., 1983. Limited-Dependent and Qualitative Variables in Econometrics. Cambridge: Cambridge University Press.

Morgan, Donald P., and Kevin J. Stiroh, 2001. "Market discipline of banks: The asset test." Journal of Financial Services Research 20, 195-208.

Meyer, L., 1999. "Market discipline as a complement to bank supervision and regulation." Speech before the Conference on Reforming Bank Capital Standards, Council on Foreign Relations, New York, June 14.

Morgan, D. and K. Stiroh, 2000. "Bond Market Discipline of Banks: Is the Market Tough Enough?" in Proceedings of a Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, 494-26.

Morgan, D. and K. Stiroh, 2001. "Market Discipline of Banks: The Asset Test." Journal of Financial Services Research 20, 233-66.

Moskow, M., 1998. "Regulatory Efforts to Prevent Banking Crises," in Preventing Bank Crises: Lessons from Recent Global Bank Failures, Caprio, G., W.C. Hunter, G. Kaufman and D. Leipziger, editors. World Bank: Washington D.C.

Penas, M. and H. Unal, 2004. "Gains in Bank Mergers: Evidence from the Bond Markets." Journal of Financial Economics 74, 149-179.

Ronn, Ehud and Avinash Verma, 1987. "Multi-Attribute Comparative Evaluation of Relative Risk For a Sample of Banks." Journal of Banking and Finance 11, 499-523.

Seale, G. and E. Bloecher, 2001. "Using Market Information to Improve the FDIC.s Off-Site Monitoring of Banks." Discussion Paper, Federal Deposit Insurance Corporation, April.

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 20, 233-66.

Sironi, A., 2003 "Testing for Market Discipline in the European Banking Industry: Evidence from Subordinated Debt Issues," Journal of Money, Credit, and Banking 35, 443-72.

Stern, G.H., 2003. "Using Market Data in Supervision," in Proceedings of a Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, 81-88.

U.S. Shadow Regulatory Committee, 2000. Reforming Bank Capital Regulation. The AEI Press: Washington D.C.

Yu, F., 2003. "Accounting Transparency and the Term Structure of Credit Spreads." Working Paper, University of California, Irvine, April.

Table 1
Variable Description

Variable	Variable Description
SPREAD	Bond yield minus maturity matched U.S. Treasury yield (basis point).
ASSETS	Log of total assets.
D_BANK	Binary variable – equals 1 for bank-issued bonds, zero otherwise (for BHC-issued bonds).
TTM_LONG	Indicator for time to maturity of at least 5 years, zero otherwise.
$D\_Issue_{I,t}$	Binary variable -- equals 1 if the banking firm issued publicly traded securities in the current quarter or the previous quarter, zero otherwise.
PAST_Issue	Binary variable – equals 1 if the banking firm issued debt in the 6-12 month period prior to the current quarter, zero otherwise.
CAPNEED	Binary variable for capital need =1 if 'C' rating (in the CAMEL rating) is 3, 4, or 5; zero otherwise. The CAMEL ratings are assigned by bank regulators, where C=Capital, A=Asset quality, M=Management, E=Earnings, L=Liquidity.
PE_CAPNEED	Interactive term of the bank's price earnings ratio and the binary variable *CAPNEED.*
SPRATE	Cardinalized S&P credit rating where less creditworthy banks (lower alphabetical rating) are converted to a larger numerical rating (see Jagtiani, Kaufman, Lemieux 2002).
MKTLEV	Ratio of total liabilities (book) divided by market value of common stocks plus book value of preferred stocks.
NPLOAN	The ratio of nonaccruing non-performing loans to total assets (%).
OREO	Other real estate owned to total assets (%).
ROA	The ratio of net income to total assets (%).
TBILL_3M	3-mo Treasury yield (%).
UNEMP	National unemployment rate (%).
D_EXPAND	Binary variable equal to one for the period of economic expansion (defined by the NBER), zero otherwise.

Table 2
Data Summary Statistics and
Cardinalization of the S&P Rating

Panel A: Summary Statistics

	Issuance Subsample		Non-Issuance Subsample	
	Mean	**Std Error**	**Mean**	**Std Error**
SPREAD (bp)	90.78	66.65	102.91	75.98
Total Assets ($Millions)	1,135	863	822	762
Time To Maturity (year)	6.99	4.20	7.37	4.76
TBILL_3M (%)	4.62	1.04	4.63	1.02
UNEMP (%)	5.89	0.95	5.73	1.06
MKTLEV (%)	13.81	13.99	19.10	27.52
NPLOAN (% of Assets)	0.94	1.09	0.75	0.78
OREO (% of Assets)	0.28	0.39	0.26	0.34
ROA (% of Assets)	0.69	0.40	0.75	0.44
SPRATE	3.12	0.54	3.17	0.52

Panel B: The Cardinalization of S&P Credit Rating

AAA	1.00	BBB+	8.00	CCC+	17.00
AA+	2.00	BBB	9.00	CCC	18.00
AA	3.00	BBB-	10.00	CCC-	19.00
AA-	4.00	BB+	11.00	CC+	20.00
A+	5.00	BB	12.00	CC	21.00
A	6.00	BB-	13.00	CC-	22.00
A-	7.00	B+	14.00	C+	23.00
		B	15.00	C	24.00
		B-	16.00	C-	25.00

Based on Jagtiani, Kaufman, and Lemieux (2002) and Ronn and Verma (1987)

Table 3: Basic Risk-spread Analysis
-OLS Regression Results-

The estimation is based on equation (2), where the dependent variable is sub-debt spread (*SPREAD*). The analysis is based on the 1990-1999 period, and it is performed separately for the two subsamples – Panel A includes 302 issuance observations where *D_Issue*=1; Panel B includes 304 non-issuance observations where *D_Issue*=0. Description of the independent variables are summarized in Table 1. t-statistics are in parentheses. The ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. The marginal R^2 is calculated relative to the basic model specification that includes only economic and control factors. F-test (1) is for the hypothesis that coefficients of all the balance-sheet risk characteristics are jointly zero. F-test (2) is for the hypothesis that coefficients of all the risk characteristics (including the S&P rating) are jointly zero.

Panel A: Risk-spread Relationship for the Issuance Subsample (N=302)

	(1)	(2)	(3)	(4)
TBILL_3M	18.00*** (3.19)	9.56** (2.10)	15.10*** (3.36)	10.50** (2.32)
UNEMPLOY	24.60*** (3.88)	-0.34 (-0.06)	15.80*** (3.32)	6.85 (1.08)
D_EXPAND	-150.80*** (-5.26)	-133.70*** (-4.57)	-146.00*** (-5.58)	-139.00*** (-5.07)
D_BANK	-4.54 (-0.67)	-14.20*** (-2.61)	-1.54 (-0.26)	-8.49 (-1.54)
ASSETS	12.60*** (3.24)	-9.40*** (-2.86)	12.50*** (3.61)	1.93 (0.44)
TTM_Long	38.00*** (5.97)	23.00*** (4.29)	32.70*** (5.94)	27.20*** (4.90)
NPLOAN	--	27.70*** (4.65)	--	17.70*** (2.62)
ROA	--	-15.50*** (-2.81)	--	-12.20** (-2.21)
OREO	--	-2.82 (-0.25)	--	-24.90** (-2.44)
MKTLEV	--	0.16 (1.11)	--	0.09 (0.63)
SPRATE	--	--	43.30*** (8.25)	33.90*** (3.95)
R^2 (Adjusted)	54.7%	64.7%	65.6%	67.3%
Marginal R^2 -- From (1)	--	10.0%	10.9%	12.6%
Marginal R^2 -- From (3)	--	--	--	1.7%
RMSE	45.9	40.3	40.1	39.1
Reduction in RMSE – From (1)	--	5.6	5.8	6.8
F-test (1) – B/S Risks	--	11.20***	--	3.22**
F_test (2) – All Risks	--	--	--	16.60***
Risk-Spread Net Effect	--	35.4 bp	--	14.9 bp

Table 3: Basic Risk-spread Analysis (Continued)
-OLS Regression Results-

The estimation is based on equation (2), where the dependent variable is sub-debt spread (*SPREAD*). The analysis is based on the 1990-1999 period, and it is performed separately for the two subsamples – Panel A includes 302 issuance observations where *D_Issue*=1; Panel B includes 304 non-issuance observations where *D_Issue*=0. Description of the independent variables are summarized in Table 1. t-statistics are in parentheses. The ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. The marginal R^2 is calculated relative to the basic model specification that includes only economic and control factors. F-test is for the hypothesis that all the risk characteristics are jointly not significantly different from zero.

Panel B: Risk-spread Relationship for the Non-Issuance Subsample (N=304)

	(1)	(2)	(3)	(4)
TBILL_3M	14.60** (2.02)	13.80** (2.15)	13.60** (2.43)	14.00** (2.50)
UNEMPLOY	17.40*** (3.55)	-2.11 (-0.42)	-4.06 (-0.91)	-6.69 (-1.37)
D_EXPAND	-158.40*** (-3.92)	-148.50*** (-3.89)	-153.60*** (-4.67)	-151.60*** (-4.60)
D_BANK	14.50* (1.85)	0.53 (0.08)	6.83 (1.07)	3.13 (0.46)
ASSETS	-2.97 (-0.76)	-10.30** (-2.53)	4.38 (1.16)	1.70 (0.35)
TTM_Long	14.80** (2.10)	23.00*** (3.10)	26.40*** (3.70)	29.30*** (3.83)
NPLOAN	--	9.97 (1.16)	--	0.19 (0.02)
ROA	--	6.96 (0.93)	--	7.86 (1.12)
OREO	--	57.80*** (2.78)	--	26.30 (1.57)
MKTLEV	--	0.08 (0.88)	--	0.12 (1.14)
SPRATE	--	--	64.70*** (6.95)	56.10*** (5.12)
R^2 (Adjusted)	41.3%	46.9%	52.3%	52.6%
Marginal R^2 -- From (1)	--	5.6%	11.0%	11.3%
Marginal R^2 -- From (3)	--	--	--	0.3%
RMSE	58.2	55.1	52.6	52.4
Reduction in RMSE – From (1)	--	3.1	5.6	5.8
F-test (1) – B/S Risk Measures	--	10.40***	--	2.04*
F_test (2) – All Risk Measures	--	--	--	13.70***
Risk-Spread Net Effect	--	29.4 bp	--	9.0 bp

Table 4: Extended Risk-Spread Model
With Sample Selection Bias Correction, Year Fixed-Effects, and Firm Fixed-Effects

The estimation is based on equation (4), where the dependent variable is sub-debt spread (*SPREAD*). The analysis is performed separately for the two subsamples – Panel A includes 302 issuance obs. where *D_Issue*=1; Panel B includes 304 non-issuance obs. where *D_Issue*=0. The inverse Mill's ratio (λ_1) is estimated using the standard Heckman correction procedure using the entire sample. The alternative inverse Mill's ratio (λ_2) is estimated separately in each year, allowing for variation in the probability of debt issuance through time. Results in Columns 4, 5, and 6 (using λ_2) are based on the period 1991-1998 only, since there are not enough number of spread observations in 1990 and 1999 to estimate Lambda2 separately in each year. t-statistics are in parentheses. The marginal R^2 is calculated relative to the basic model specification that includes only economic and control factors. F-test (1) is for the hypothesis that coefficients of all the balance-sheet risks are jointly zero. F-test (2) is for the hypothesis that coefficients of all the risk characteristics (including S&P rating) are jointly zero. The t-statistics are in parentheses. The ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A: Issuance Subsample

	(1)	(2)	(3)	(4)	(5)	(6)
TBILL_3M	-26.00*** (-2.66)	-7.25 (-0.94)	-21.50** (-2.30)	-22.00** (-2.29)	-5.19 (-0.71)	-18.40*** (-2.03)
UNEMPLOY	-56.90*** (-2.75)	-1.30 (-0.11)	-39.90* (-1.85)	-58.80*** (-3.54)	-3.64 (-0.36)	-43.70*** (-2.61)
D_EXPAND	-37.30 (-1.45)	-51.40** (-2.24)	-40.40 (-1.56)	-34.80 (-1.20)	-49.00* (-1.91)	-37.90 (-1.34)
D_BANK	-53.90** (-2.27)	-27.20 (-1.18)	-34.70* (-1.68)	-13.00 (-1.36)	8.11 (0.74)	-0.78 (-0.08)
ASSETS	-22.90** (-2.28)	7.49 (0.72)	-8.91 (-0.97)	-6.80 (-1.02)	15.80* (1.93)	2.10 (0.31)
TTM_Long	16.40*** (2.83)	22.00*** (3.93)	20.60*** (3.54)	9.69** (2.44)	14.60*** (3.79)	13.10*** (3.38)
NPLOAN	13.70** (2.53)	--	4.94 (0.75)	18.70*** (4.14)	--	9.73* (1.88)
ROA	-30.10*** (-3.78)	--	-21.80*** (-2.64)	-27.60*** (-3.91)	--	-20.40*** (-2.98)
OREO	9.21 (0.76)	--	-15.00 (-1.25)	11.70 (1.17)	--	-5.59 (-0.58)
MKTLEV	0.37** (3.01)	--	0.30* (1.77)	0.16 (1.06)	--	0.14 (0.98)
SPRATE	--	44.80*** (7.33)	36.30*** (3.64)	--	45.00*** (7.55)	30.40*** (3.60)
λ_1	-33.90*** (-2.87)	-25.40*** (-2.65)	-26.10** (-2.43)	--	--	--
λ_2	--	--	--	-5.60*** (-3.12)	-4.29** (-2.55)	-4.66*** (-2.90)
R^2 (Adjusted)	79.5%	79.8%	80.6%	76.2%	76.4%	77.6%
Marginal R^2	3.6%	3.9%	4.7%	7.2%	7.4%	8.6%
Marginal R^2 -- From previous column	--	--	0.8%	--	--	1.2%
F-test (1) – B/S Risks	8.51***	--	2.78**	15.1***	--	2.84**
F_test (2) – All Risks	--	--	13.30***	--	--	15.50***
Risk-Spread Net Effect	37.3 bp	--	15.0 bp	37.1 bp	--	18.8 bp
Observation Number	302	302	302	283	283	283

Table 4: Extended Risk-Spread Model
With Sample Selection Bias Correction, Year Fixed-Effects, and Firm Fixed-Effects

The estimation is based on equation (4), where the dependent variable is sub-debt spread (*SPREAD*). The analysis is performed separately for the two subsamples – Panel A includes 302 issuance obs. where *D_Issue*=1; Panel B includes 304 non-issuance obs. where *D_Issue*=0. The inverse Mill's ratio (λ_1) is estimated using the standard Heckman correction procedure using the entire sample. The alternative inverse Mill's ratio (λ_2) is estimated separately in each year, allowing for variation in the probability of debt issuance through time. Results in Columns 4, 5, and 6 (using λ_2) are based on the period 1991-1998 only, since there are not enough number of spread observations in 1990 and 1999 to estimate Lambda2 separately in each year. t-statistics are in parentheses. The marginal R^2 is calculated relative to the basic model specification that includes only economic and control factors. F-test (1) is for the hypothesis that coefficients of all the balance-sheet risks are jointly zero. F-test (2) is for the hypothesis that coefficients of all the risk characteristics (including S&P rating) are jointly zero. The t-statistics are in parentheses. The ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Panel B: Risk-spread Relationship for the Non-Issuance Subsample (N=304)

	(1)	(2)	(3)	(4)	(5)	(6)
TBILL_3M	-9.10 (-1.29)	-6.74 (-1.14)	-4.86 (-0.69)	-11.70** (-2.01)	-9.80* (-1.87)	-8.74 (-1.49)
UNEMPLOY	-27.50 (-1.24)	-29.00** (-2.12)	-23.10 (-1.13)	-19.70 (-1.26)	-21.80* (-1.94)	-18.50 (-1.19)
D_EXPAND	-67.30** (-2.25)	-67.00** (-2.41)	-73.10*** (-2.63)	-79.50** (-2.11)	-74.40** (-2.11)	-79.50** (-2.23)
D_BANK	-45.00*** (-2.81)	3.28 (0.20)	-5.72 (-0.28)	-39.50*** (-2.75)	4.48 (0.28)	-14.50 (-0.72)
ASSETS	16.20 (1.24)	17.30 (1.30)	17.70 (1.43)	11.90 (0.97)	16.10 (1.26)	13.80 (1.12)
TTM_Long	37.80*** (4.02)	24.40*** (3.19)	31.20*** (3.59)	22.20*** (2.60)	15.60** (2.31)	18.50** (2.35)
NPLOAN	-8.93 (-1.09)	--	-16.30* (-1.88)	1.12 (0.14)	--	-3.59 (-0.41)
ROA	5.41 (0.74)	--	6.78 (1.00)	4.46 (0.90)	--	5.19 (1.04)
OREO	66.00*** (4.27)	--	32.00** (2.33)	55.10*** (3.90)	--	33.80*** (2.70)
MKTLEV	-0.25 (-1.45)	--	-0.28* (-1.71)	-0.07 (-0.48)	--	-0.10 (0.70)
SPRATE	--	52.30*** (5.47)	54.80*** (3.77)	--	44.00*** (4.79)	34.30** (2.40)
λ_1	-18.10 (-1.35)	-18.20 (-1.45)	-21.30 (-1.59)	--	--	--
λ_2	--	--	--	-2.46 (-0.47)	-5.41 (-0.98)	-3.60 (-0.66)
R^2 (Adjusted)	71.7%	72.9%	73.5%	64.1%	65.3%	65.4%
Marginal R^2	1.3%	2.5%	3.1%	2.4%	3.6%	3.7%
Marginal R^2 -- From (3)	--	--	0.6%	--	--	0.1%
F-test (1) – B/S Risks	7.94***	--	3.54***	8.96***	--	2.84**
F_test (2) – All Risks	--	--	11.60***	--	--	10.70***
Risk-Spread Net Effect	7.7 bp	--	-12.9 bp	17.6 bp	--	4.5 bp
Observation Number	304	304	304	267	267	267

Table 5: Extended Risk-spread Model
Using Entire Sample and Interactive Issuance Indicator & Risk Measures

The estimation is based on equation (5). The Marginal R^2 Is calculated based on the specification that includes only economic and control factors. The F-test is for the hypothesis that all the interactive issuance & balance sheet risk variables (the marginal impacts of risk) are jointly zero. The risk variables in F-test (1) include only balance-sheet risk (excluding *SPRATE*) while F-test (2) include all risk factors. t-statistics are in parentheses. The ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. Number of observations used are 606 for columns (1) to (3) and 550 for columns (4) to (6). RMSE for a specification that include only control factors are 32.2 (when using λ_1) and 40.6 (when using λ_2).

	(1)	(2)	(3)	(4)	(5)	(6)
TBILL_3M	-16.60*** (-2.65)	-8.69* (-1.77)	-12.20** (-2.03)	-19.10*** (-3.35)	-10.40** (-2.24)	-14.80*** (-2.71)
UNEMPLOY	-42.50** (-2.55)	-18.7* (-1.91)	-29.40* (-1.85)	-41.80*** (-3.55)	-16.20** (-2.09)	-30.40*** (-2.67)
D_EXPAND	-48.10* (-1.95)	-54.20** (-2.44)	-56.30** (-2.47)	-60.90** (-2.05)	-65.50** (-2.43)	-64.80** (-2.33)
D_BANK	-39.00*** (-3.40)	-7.53 (-0.66)	-8.40 (-0.62)	-30.20*** (-3.37)	0.92 (0.10)	-6.89 (-0.60)
ASSETS	11.40 (1.32)	21.20** (2.51)	20.20** (2.25)	4.43 (0.61)	16.70** (2.29)	12.40 (1.58)
TTM_Long	23.20*** (4.66)	21.90*** (5.04)	24.90*** (5.15)	12.80*** (3.02)	15.20*** (4.22)	14.80*** (3.56)
NPLOAN	-2.22 (-0.32)	--	-11.10 (-1.50)	7.01 (1.07)	--	-1.35 (-0.19)
ROA	-6.46 (-1.08)	--	1.95 (0.31)	-7.21 (-1.60)	--	-1.08 (-0.22)
OREO	45.50*** (3.34)	--	19.60* (1.73)	37.50*** (2.90)	--	18.20* (1.74)
MKTLEV	-0.07 (-0.70)	--	-0.08 (-0.81)	-0.04 (-0.52)	--	-0.05 (-0.59)
*D * NPLOAN*	12.90** (1.99)	--	9.05 (1.43)	8.35 (1.45)	--	6.19 (1.12)
*D * ROA*	-13.20*** (-2.84)	--	-17.00** (-2.49)	-11.30*** (-2.63)	--	-12.10* (-1.81)
*D * OREO*	-26.30* (-1.65)	--	-30.00** (-2.13)	-15.10 (-1.03)	--	-15.90 (-1.28)
*D * MKTLEV*	0.15 (0.86)	--	0.05 (0.31)	0.13 (0.89)	--	0.07 (0.54)
SPRATE	--	49.10*** (7.39)	49.50*** (4.83)	--	47.40*** (7.25)	38.20*** (3.91)
*D * SPRATE*	--	0.13 (0.13)	4.08 (1.55)	--	0.13 (0.15)	1.97 (0.82)
λ_1	-3.27 (-0.50)	-7.24 (-1.30)	-5.15 (-0.83)	--	--	--
λ_2	--	--	--	-4.73*** (-2.57)	-5.16** (-2.09)	-4.59* (-1.81)
R^2 (Adjusted)	73.2%	75.3%	75.5%	67.4%	69.7%	69.8%
RMSE -- Issuance	30.4	29.6	29.2	24.3	23.6	23.2
RMSE Reduction – Issuance	1.8	2.7	3.0	3.0	3.7	4.1
RMSE – Non-Issuance	39.8	38.3	37.9	32.8	31.8	31.6
RMSE Reduction – Non-Issuance	0.8	2.3	2.7	1.4	2.3	2.5
F-test (1)	3.28**	--	3.02**	2.44**	--	1.68
F_test (2)	--	--	2.45**	--	--	1.40
Difference Risk-Spread Net Effect	11.50 bp	--	5.97 bp	10.10 bp	--	6.88 bp

Appendix I: Primary Market

Basic Risk-spread Analysis Using Standard OLS Regression

The estimation is based on equation (2), where the dependent variable is sub-debt spread (*SPREAD*). The analysis is based on the 1990-1999 period. Description of the independent variables are summarized in Table 1. The t-statistics are in parentheses. The ***, **, and * denote statistically significance at the 1%, 5%, and 10% level, respectively. The marginal R^2 is calculated relative to the basic model specification that includes only economic and control factors. F-test is for the hypothesis that all the risk characteristics are jointly not significantly different from zero. Note that the binary variable indicating that the bond's time to maturity being 5 years or longer (*TTM_LONG*) is not included here because it has the same value (equals 1) for all the primary market observations.

Risk-spread Relationship for the Primary Market Sample (N=68)

	(1)	(2)	(3)	(4)
TBILL_3M	28.60*** (4.41)	20.40*** (4.30)	22.90*** (6.41)	20.60*** (5.26)
UNEMPLOY	35.70*** (3.73)	9.85 (1.51)	26.90*** 4.68)	15.70** (2.27)
D_EXPAND	-3.19 (-0.12)	-15.4 (-0.94)	-23.40 (-1.10)	-21.40 (-1.28)
D_BANK	0.69 (0.06)	-2.26 (-0.34)	10.60 (1.33)	3.36 (0.44)
ASSETS	2.03 (0.30)	-20.80*** (-4.88)	9.50 (1.60)	-11.8** (-2.30)
NPLOAN	--	21.80*** (2.88)	--	16.50** (2.20)
ROA	--	-23.80*** (-2.95)	--	-21.00** (-2.37)
OREO	--	11.50 (0.68)	--	-4.14 (-0.24)
MKTLEV	--	1.27** (2.58)	--	1.22** (2.54)
SPRATE	--	--	42.90*** (6.56)	21.30** (2.27)
R^2 (Adjusted)	35.4%	69.7%	63.9%	72.2%
Marginal R^2 -- From (1)	--	34.3%	28.5%	36.8%
Marginal R^2 -- From (3)	--	--	--	8.3%
F-test (1) – B/S Risks	--	17.50***	--	16.40***
F_test (2) – All Risks	--	--	--	3.70***
Risk-Spread Net Effect	--	61.9 bp	--	48.9 bp

Appendix II: Probit Analysis for Issuing Decision Using Entire Sample – 606 Observations

The estimation is based on equation (3), where the dependent variable is the binary variable that indicates whether the bank has new debt issue in the current or previous quarter (*D_Issue*). The analysis is based on the 1990-1999 period. Description of the independent variables are summarized in Table 1. The ***, **, and * denote statistically significance at the 1%, 5%, and 10% level, respectively.

$$\begin{aligned} D\_Issue_{i,t} &= \alpha_0 + \alpha_1(UNEMP_t) + \alpha_2(GDP_t) + \alpha_3(TBILL\_3M_t) + \\ &\alpha_4(D\_EXPAND_t) + \alpha_5(ASSETS_{i,t}) + \alpha_6(MKTLEV_{i,t}) + \alpha_7(NPLOAN_{i,t}) \\ &+ \alpha_8(OREO_{i,t}) + \alpha_9(ROA_{i,t}) + \alpha_{10}(CAPNEED_{i,t}) + \alpha_{11}(PE\_CAPNEED_{i,t}) \\ &+ \alpha_{12}(PAST\_Issue_{i,t}) + \alpha_{13}(SPRATE_{i,t}) + \mu_{i,t} \end{aligned} \qquad \text{------} \quad (3)$$

	Coefficient	t-statistics
TBILL_3M	0.1221	1.49
UNEMPLOY	0.3506***	3.65
D_EXPAND	0.0251	0.08
ASSETS	0.3643***	4.16
MKTLEV	-0.0094***	-2.90
NPLOAN	0.0249	0.21
OREO	-0.6729**	-2.28
ROA	0.0804	0.56
CAPNEED	1.1882**	2.48
PE_CAPNEED	-0.3206	-0.74
PAST_ Issue	0.6223***	5.51
SPRATE	-0.0902	-0.58
Log Likelihood	-365.64	
Pseudo-R^2	17.5%	