MARKET DISCIPLINE IN BANKING RECONSIDERED: THE ROLES OF DEPOSIT INSURANCE REFORM, FUNDING MANAGER DECISIONS AND BOND MARKET LIQUIDITY

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ABSTRACT

Researchers, market participants and bank supervisors use the risk sensitivity of a banking organization's subordinated debt yield spreads in the secondary market as a barometer both of the organization's health and of the potential for the market to discipline the firm's behavior. This paper shows that this gauge may understate the potential for market discipline in some periods and overstate it in others because such spreads contain liquidity premiums that are driven, in part, by the risk-sensitivity of funding manager decisions. Put differently, we demonstrate that estimates of risk premiums can be seriously biased when the dependence of liquidity premiums on the risk-sensitive managerial decision to issue debt is ignored.

When such dependence is controlled for, we are able to resolve a major anomaly in existing research, provide a new perspective on the extent of market discipline over the last two decades, and suggest a new rationale for requiring banks to issue subordinated debt. Studies using data prior to FDIC Improvement Act reforms have found little evidence of market discipline in (bankruptcy exposed) subordinated debt spreads, but significant evidence of market discipline in (bankruptcy remote) bank CD spreads. In addition, existing studies find evidence of market discipline in subordinated debt markets after FDICIA. After adjusting for the sample selection bias inherent in previous research, we find evidence of market discipline in the subordinated debt market before FDICIA. Moreover, it appears that the strength of this discipline was, after controlling for risk-sensitive debt issuance decisions, about the same in the pre- and post-FDICIA periods. Thus, FDICIA may not have induced as large an increase in market discipline as previous studies have argued for, and market discipline in the pre-FDICIA period may not have been as weak. Lastly, we argue that our results suggest that a policy of mandating the regular issuance of subordinated debt would, by reducing the endogeneity of liquidity premiums, improve the information content of both primary and secondary market debt spreads, thus augmenting both direct and indirect market discipline.

I. INTRODUCTION

An increasingly important issue in the regulation and supervision of banking organizations concerns the extent to which market investors can identify and control the risks of banks. For example, a fundamental element of the New Basel Capital Accord is the recognition that market discipline can: (1) provide a bank with an incentive to maintain a strong capital base as a cushion against potential future losses, and (2) be used by bank supervisors as a "lever to strengthen the safety and soundness of the banking system."[1]

One security that has been hypothesized to have the potential to create market discipline is subordinated debt. Among bank liabilities, subordinated notes and debentures are uninsured and among the first (after equity) to lose value in the event of bank failure. Investors in said instruments are exposed to loss, but their potential upside gains are contractually limited. Thus, the incentive of subordinated note and debenture investors to monitor and limit risk-taking is similar to that of bank supervisors and in stark contrast to that of equity investors.

Over the last two decades, several deposit insurance reforms were implemented that may have changed the protection provided to investors in subordinated notes and debentures issued by large U.S. banking organizations. The decade of the 1980s began with considerable *de jure* protection (by federal bankruptcy and bank failure legislation) provided to subordinated debt holders.[2] By the mid-1980s, however, the Federal Deposit Insurance Corporation (FDIC) had put in place mechanisms (e.g., purchase and assumption transactions) by which it could rescue an insured bank subsidiary without protecting the holding company, or even all of the creditors of the insured bank.[3] In 1991, the Federal Deposit Insurance Corporation Improvement Act (FDICIA) required: (1) least cost resolutions of failed depositories; and, (2) established the system of prompt corrective action (PCA). Under PCA criteria, critically undercapitalized banks, defined as those with tangible equity capital less than 2 percent of total assets, must be placed in receivership within

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[1]See Basel Committee on Banking Supervision (2001).

[2]For example, in July 1984, the Federal Deposit Insurance Corporation saved Continental Illinois Bank by providing "open bank assistance." This was accomplished by purchasing a billion dollars of preferred stock in the parent holding company, which was immediately down-streamed to the bank as common equity. Flannery and Sorescu (1996, pp. 1352-1353) argue that his direct capital infusion into the parent holding company essentially protected the investors that held subordinated debentures of the parent holding company. Flannery (1998) refers to the 1984-1989 period as the too-big-to-fail (TBTF) period, while Jagtiani, Kaufman and Lemieux (2000) refer to it as the *de jure* protection period for uninsured deposits and other debt.

[3]See Flannery and Sorescu (1996, pp. 1352-1353).

90 days, unless such actions would not achieve the purposes of PCA, or within one year, unless specific statutory requirements are met.[4] Also under PCA, 60 days after a bank is determined to be critically undercapitalized, it can not make payments on subordinated debt without regulatory approval. In 1993, the National Depositor Preference Act of 1993 amended the Federal Deposit Insurance Act to establish a clear priority for the distribution of (unsecured) claims realized from the liquidation or other resolution of any insured depository. Because the National Depositor Preference Act lowered the liquidation standing of bank subordinated debt, it made it more likely that subordinated investors would incur losses in the event of a bank failure.[5]

The implementation of these deposit insurance reforms has provided researchers with an opportunity to consider their effects on the strength of the market discipline exerted by subordinated debt investors. To this end, it has become standard practice to use the risk sensitivity of secondary market prices for banking organization subordinated notes and debentures as a barometer for the potential of market discipline to effectively and constructively augment regulatory and supervisory controls for bank risk-taking.[6] Because bank-specific risk measures have explained a *larger* proportion of the cross-sectional variation in secondary subordinated debt spreads over comparable maturity Treasury securities *after* deposit insurance reforms were implemented, this evidence has been considered to be consistent with an *increase* in market discipline as a result of such reforms.[7]

Although the stylized fact that the risk-sensitivity of secondary subordinated debt spreads

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[4]See Jones and King (1995). FDICIA required federal banking agencies to implement a capital-based policy of PCA that would begin in December 1992.

[5]See Section 11(d)(11) of the Federal Deposit Insurance Act (codified as amended at 12 U.S.C. §1821(d)(11)(2000)).

[6]Board of Governors of the Federal Reserve System and United States Department of the Treasury (2000) provides a summary of empirical studies on the effectiveness of market discipline exerted on banking organizations by uninsured liabilities, such as subordinated notes and debentures.

[7]Studies using subordinated debt market data exclusively from the 1983-1984 period (e.g., Avery, Belton, and Goldberg (1988) and Gorton and Santomero (1990)) were unable to detect a significant correlation between bank-specific accounting risk measures and either secondary subordinated debt spreads, or the implied asset volatilities derived from such spreads. In contrast, studies using subordinated debt market data from subsequent deposit insurance regulatory regimes (e.g., Hassan (1993), Hassan, Karels and Peterson (1993), Flannery and Sorescu (1996), Jagtiani, Kaufman and Lemieux (2000), DeYoung, Flannery, Lang and Sorescu (2001), Hancock and Kwast (2001) and Morgan and Stiroh (2001)) have consistently found evidence that subordinated debt spreads are closely correlated with various indicators of bank risk, including non-accruing loans-to-assets, past due loans-to-assets, "other real estate owned"-to-assets, the ratio of (book) equity-to-assets, the ratio of total (book) liabilities-to-the (market value of common stock plus the book value of preferred stock), cardinalized S&P or Moody's bond ratings, supervisory ratings, and portfolio shares for lending and trading activities.

increased after deposit insurance reforms were implemented has been documented by numerous studies, less attention has been paid to the cause for this heightened sensitivity to risk. It has generally been presumed that subordinated investors became more diligent about pricing bank default risks as regulators reduced protection for large bank holding companies' creditors.[8] This "demand-side" explanation for the observed change in the risk-sensitivity of subordinated debt spreads, however, ignores the "supply-side" of the subordinated debt market, which would include responses by funding managers for large U.S. banking organizations to deposit insurance reforms.

No doubt, the optimal capital structure for large U.S. banking organizations evolved as modifications were made to resolution methods and to supervisory policies with respect to troubled banks. First, such policy reforms would have changed each organization's expected costs of financial distress.[9] Because risk neutral creditors adjust their required interest rate by the firm's expected costs of financial distress, shareholders may choose a different capital ratio for the bank to reduce their own expected costs of financial distress. Second, as reforms made default more credible for large banking organizations, such organizations may have adopted funding strategies that are similar to those used by other firms: Corporate entities have typically tended to reduce their reliance on debt by shifting toward equity financing when their default probability rises (Castanias (1983) and Marsh (1982)) and have been more likely to issue long-term debt when business conditions are favorable (i.e., when they expect other firms to issue debt) (Marsh (1982), Bikhchandani, Hirshleifer and Welch (1998), MacKay and Phillips (2002), and Welch (2002)).

Since funding decisions are likely to be sensitive to the current and prospective financial condition of a banking organization and to general business conditions, the age of outstanding subordinated debt issues outstanding at each point in time is likely to depend on such factors as well. Banking organizations that are currently relatively risky may be more likely to have older issues outstanding, *ceteris paribus*, than would today's safer banking organizations. This is because the riskier organizations may have higher expected financial distress costs and a higher probability of default than would relatively safer organizations. And when business conditions are unfavorable,

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[8]See, for example, Flannery and Sorescu (1996, p. 1374).

[9]Financial distress costs not only include costs of bankruptcy (i.e., the costs of transferring ownership of the firm from shareholders to creditors), but also include the loss in value that may occur as a result of the perception that bankruptcy may be imminent (i.e., costs associated with the delay of interest payments), even if bankruptcy is ultimately avoided. See Berger et al. (1995) for a discussion of the effects of financial distress on the optimal capital structure of a banking organization.

the age of debt securities outstanding may lengthen as it is less likely for firms to issue long-term debt when other firms are not issuing such debt as well.

Age matters when bond spreads are used to assess expected default risks because older bonds tend to be less frequently traded in the bond market, implying that investors require larger premiums for bearing the risk associated with the difficulty of turning such bonds into cash before they mature.[10] Older, or "off-the-run," issues generally become absorbed into investors' portfolios.[11] Moreover, dealer inventories of a bond tend to decline as it ages.[12] As this process occurs, the issues become less liquid, particularly if the issuer of the older debt has not recently brought any large issues to the bond market. Indeed, aging is important even for government bonds, since U.S. Treasury bills display greater liquidity (i.e., lower yields and lower bid-ask spreads) than otherwise comparable U.S. Treasury notes near their maturity dates.[13] Empirically, the dearth of liquidity for older bonds presents itself through larger discrepancies in recorded prices across alternative data sources.[14] These discrepancies, both for government bonds and for corporate bonds, tend to increase with a bond's age and decrease for larger issues. Like other corporate bonds, discrepancies in recorded prices across alternative data sources for subordinated notes and debentures issued by large U.S. banking organizations tend to increase with the issue's age and decline with issuance size (Hancock and Kwast (2001)). This evidence suggests that subordinated bonds issued by U.S.

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[10]The observation that bond liquidity is positively priced was made at least as early as Fisher (1959).

[11]See Sarig and Warga (1989), Amihud and Mendelson (1991), and Board of Governors of the Federal Reserve System (1999, p. 46). Beim (1992) argues that many bond buyers are institutions that seek to match sets of liabilities with portfolios of fixed-rate assets, so such buyers decide to be non-traders. In addition, because bond trading involves not only transactions costs, but also compensation for skilled persons to conduct such activities, smaller and conservative institutions tend to decide to be non-traders (Beim(1992)).

[12] See Kamara (1994, p. 412).

[13]Amihud and Mendelson (1991) report that the mean yield difference between notes and comparable bills was 0.43% in 1987. Similarly, Kamara (1990) found a mean yield difference between notes and comparable bills of 0.34% for the 1977-1984 period.

[14]For bonds that are not actively traded, large discrepancies in prices can develop because: (1) each source uses different traders or broker-dealers for price information and their price records need not be simultaneous when a bond is not actively traded; (2) exchange-based prices can contain significant liquidity-driven noise; and, (3) it is difficult for investors to arbitrage price differences between illiquid securities. Sarig and Warga (1989) report that discrepancies in government bond prices across alternative data sources increase with a bond's age and its bid-ask spread and that such discrepancies decrease with the amount of bonds outstanding. For corporate bonds, Warga (1991) report that bid-ask spreads, which are indicative of trader uncertainty about the true price of a bond, increase with the age of the bond and decrease with the issue amount outstanding.

banking organizations are less liquid as they become more seasoned, particularly for issues that are of small issuance size. Therefore, the yields on older outstanding subordinated bonds are likely to contain larger liquidity premiums than more recently issued subordinated bonds.

These arguments suggest that *observed* secondary prices on subordinated notes and debentures could reflect both the diligence of creditors and the actions of the funding manager. On the one hand, the increased risk-sensitivity of secondary market subordinated debt spreads after deposit insurance reforms may have come from such spreads embodying a more precise premium for credit risks. On the other hand, this increased risk-sensitivity may have resulted from the presence of liquidity premiums that were generated by funding manager actions conditioned on their assessments of expected financial distress costs and the probability of default for their organization after deposit reforms were put in place.

This paper considers the evolving roles of funding manager issuance decisions and bond market liquidity in determining observed secondary yields on subordinated debt instruments issued by large U.S. banking organizations during recent deposit insurance regimes. To accomplish this objective, a three-part strategy is employed. First, a probit style model is used to consider whether the decision to issue subordinated debt was affected by bank-specific risks, general business conditions, and other factors during several regulatory regimes: (1) the "*de jure* protection" (1986-1987) regime; (2) the "purchase and assumption" (1988-1992) regime; (3) the pre-FDICIA (1986-1992) regime; and, (4) a post-FDICIA (1993-1999) regime. If funding manager decisions are sensitive to the current and prospective financial condition of a banking organization or to general business conditions, then the age of subordinated debt issues outstanding is likely to depend on such factors as well. Hence, issuance decision model estimates can be used to infer when secondary market spreads contain liquidity premiums correlated with bank-specific risks and/or general business conditions. Second, a sample selection model, which incorporates the issuance decision model, is used to consider the risk-sensitivity of *observed* issuance spreads (over comparable maturity Treasury securities) as well as the effects of instrument characteristics (e.g., issue size and frequency of coupon payments) on such spreads. At the time of issue, each instrument is most likely to be "on-the-run," rather than "off-the-run." Thus, by considering the risk-sensitivity of observed issuance spreads, the potentially important effects of liquidity differences on bond spreads are minimized. Moreover, we find that controlling for sample selection is necessary to obtain unbiased estimates for the risk-sensitivity of primary subordinated debt spreads even when the issuance

decision does not depend on bank-specific risks. Third, the empirical findings from the issuance decision model and the sample selection model for observed issuance spreads are used to reinterpret the findings of previous bank market discipline studies that analyzed the risk-sensitivity of observed secondary spreads.

We demonstrate that estimates of risk premiums can be seriously biased when the dependence of liquidity premiums on the risk-sensitive managerial decision to issue debt is ignored. When this dependence is controlled for, we are able to resolve a major anomaly in existing research, provide a new perspective on the extent of market discipline over the last two decades, and suggest a new rationale for requiring banking organizations to issue subordinated debt.

Studies using data prior to the FDICIA reforms have found little evidence of market discipline in (bankruptcy exposed) subordinated debt spreads, but significant evidence of market discipline in (bankruptcy remote) bank certificates of deposit. Using our sample selection model, we are able to detect that issuance spreads were sensitive to accounting- and market-based risk proxies, even during periods when secondary prices were not statistically sensitive to the same risk proxies.

It is conventional wisdom that FDICIA reforms increased market discipline. It appears, however, that the strength of market discipline was, after controlling for risk-sensitive debt issuance decisions, about the same in the pre- and post-FDICIA periods.

Lastly, we argue that our results suggest that a policy of mandating regular issuance of subordinated debt by U.S. banking organizations would, by reducing the endogeneity of liquidity premiums, improve the information content of both primary and secondary market debt spreads. This boost in information content could augment the market discipline imposed on such organizations.

The rest of the paper follows the three-part strategy of the empirical approach. Section II specifies the issuance decision model for large U.S. banking organization subordinated notes and debentures. Section III employs the issuance decision model in the specification of the sample selection model for observed issuance spreads on subordinated debt instruments. Parameter estimates for these empirical models are presented in section IV for the four regulatory regimes under consideration. Section V draws inferences from the estimated models about the credit-risk-sensitivity of subordinated debt spreads under different regulatory regimes and reinterprets the findings of previous market discipline studies.

II. AN ISSUANCE DECISION MODEL FOR SUBORDINATED DEBENTURES

As noted above, the funding decisions of banking organization i at time t are likely to be sensitive to the current and prospective financial condition of the organization, $E[FC_{it}]$, and to general business conditions, BC_t. In addition, the decision to issue subordinated debt may depend in part on banking organization-specific factors, OF_{it} such as an organization's expected tax-rate, that determine firm-specific expected costs and benefits associated with debt issuance, and on the amount of supervisory pressure, SP_{it}, on the firm's management to raise its regulatory capital ratio.[15] Thus, the decision to issue subordinated debt for a banking organization i at time t, $ISSUE_{it}$, depends upon $E[FC_{it}]$, BC_t, OF_{it}, and SP_{it}, or

$$ISSUE_{it} = f(E[FC_{it}], BC_{it}, OF_{it}, SP_{it}) \quad (1)$$

where the variable $ISSUE_{it}$ equals one if banking organization i decides to issue subordinated debt in period t, and zero otherwise.[16]

To measure the current and prospective financial condition of each banking organization, $E[FC_{it}]$, several bank risk proxies, which have been used in previous bank market discipline studies, are examined. These include the ratio of non-accruing loans to total assets ($NATA_{it}$), the ratio of accruing loans past due 90 days or more to total assets ($PDTA_{it}$), the ratio of other real estate owned to total assets ($OREO_{it}$), the absolute value of the difference between assets and liabilities maturing or repricing within one year as a proportion of equity value ($AGAP_{it}$), and the ratio of total book liabilities to the sum of the market value of common stock and the book value of preferred stock ($MARKETLEV_{it}$).[17] Higher values for these proxies should reflect greater risk and/or a deteriorating

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[15] See Covitz, Hancock, and Kwast (2000).

[16] To construct the $ISSUE_{it}$ variable, the CUSIP Masterfile was used to identify all subordinated debt issues by top fifty bank holding companies. Then, for each subordinated debt issue, issuance dates were assigned using Moody's, Fitch, Bloomberg, and Warga databases. $ISSUE_{it}$ equals one, if banking organization i issued subordinated debt in either quarter t or quarter $t-1$, and equals zero, otherwise.

[17] See, for example, Flannery and Sorescu (1996) and DeYoung et al. (2001). Balance sheet and income statement data are from consolidated financial statements for bank holding companies (FR Y-9C). These items are reported as of the close of business on the last calendar day of the quarter. Data on the market value of common stock are from the Center for Research in Security Prices (CRSP) tape published by the University of Chicago Graduate School of Business. Both sets of data are publicly available.

financial condition for the banking organization, so it is expected that subordinated debt issuance would be less likely as these risk proxies rise in value.

To assess the effects of business conditions on debt issuance decisions, several proxies are used to ascertain when banking organizations might expect other firms to issue debt. First, poor current macroeconomic conditions may curtail the growth prospects of many firms simultaneously. Thus, a relatively high unemployment rate (*UE*) could be a harbinger of retrenchment in debt issuance activities by the corporate sector.[18] Second, because stock market returns have been found to be negatively correlated with contemporaneous investment (Lamont (2000)) and positively correlated with subsequent corporate investment (Fama (1981), Fischer and Merton (1984), and Barro (1990)), it is likely that corporate debt issuance would also be negatively correlated with contemporaneous stock market excess returns (*XR*).[19,20] Third, bond market stress may make it difficult for some firms to issue debt. During periods when liquidity is at a premium, for example, both better known firms and larger issues are much more prominent in the primary debt market (Harrison (2001)).[21] Because bond price volatility, regardless of whether it is driven by liquidity shocks or credit-quality shocks, tends to increase underwriting costs in a nonuniform manner across firms, some firms may find it too costly to enter the public debt market when such volatility is relatively high. As a general measure for bond market stress, we use an implied stock volatility measure that is based on real-time S&P 100 (OEX) index option bid/ask quotes, which is supplied

[18]Although the parameter estimates are not reported below, model specifications were tested that included a leading indicator (the BAA interest spread) and a coincident indicator (industrial production) in addition to a lagging indicator of business conditions (i.e., the unemployment rate). These additional business condition variables did not significantly influence issuance decisions.

[19]Lags in the investment process (owing to delivery, planning, and construction lags) and time-varying risk premia can cause actual investment to be negatively correlated with current returns (Lamont (2000, p. 2720)).

[20]The influence of overall stock market excess returns on debt issuance activities may be weak. For example, Welch (2002) has argued that the observed capital structure of U.S. firms is explained well by a firm's own past capital structure and by its stock price appreciation. For the contemporaneous stock market excess return, the quarterly average of daily excess stock returns (calculated as the difference between the daily value-weighted return on NYSE, Amex, and Nasdaq stocks and the off-the-run one month Treasury return) was used.

[21]Harrison (2001) argues that a severe liquidity shock (e.g., after the Russian default in 1998:Q3) is in some ways as bad for the corporate bond market as a severe credit-quality shock (e.g., during 2000-2001). With both these types of shocks to the bond market, credit spreads widen, but issuance can be more strongly curtailed in the case of a liquidity shock as some firms in the high-yield sector are totally shut out of the public debt market.

by the Chicago Board Options Exchange (*MKTVOL)*.[22] It is expected that bond issuance activities would be negatively correlated with *MKTVOL*.

The costs and benefits of external finance are likely to vary across firms. For example, becoming a known "name" is said to lower issuance costs and to increase market demand and liquidity for an issuer's debt.[23] Because frequent issuers are likely to have issued subordinated debt more than once during an annual period, an indicator variable that equals one when the banking organization has issued subordinated debt in the previous period ($ISSUE_{i,\ t-1}$) is included in the issuance decision model to proxy for subordinated debt market name recognition.[24]

Because information is costly to analyze, major buyers of subordinated debt typically specialize so that they purchase large amounts of debt of a small number of large firms.[25] This practice tends to reduce issuance costs for larger firms. To detect this effect, the natural log of total assets, ln($ASSET_{it}$), is included in the issuance model.[26]

The existence of tax shelter benefits of corporate debt and increased risks of bankruptcy and agency costs with increased leverage not only affect the market value of each firm, but also determine its optimal capital structure. Hence, the firm's tax rate and its leverage are important inputs for its debt issuance decisions. The higher the banking organization's marginal tax rate, the greater its benefit from being able to deduct the interest payments paid to subordinated debt bondholders. As a proxy for the marginal tax rate facing each banking organization, we use its foreign and domestic income taxes as a percentage of net income (*AVGTAX*). As the amount of debt in the capital structure increases, the present value of tax savings will cause the market value of the firm to rise. However, at some point, the increased risk of bankruptcy and agency costs resulting from increased leverage will cause the market value of the firm to be less than it would have been if the only influence were taxes. Indeed, it is possible that bankruptcy and agency costs become so large that the market value of the firm would actually decline with an increase in leverage. Thus,

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[22]Implied stock volatility is exogenous to, but highly correlated with, bond market volatility.

[23]See Board of Governors of the Federal Reserve System (1999, p. 46.)

[24]More explicitly, $ISSUE_{i,\ t-1}$ equals one if banking organization *i* issued subordinated debt in either quarter *t-2*, or quarter *t-3*, and zero otherwise.

[25]See Board of Governors of the Federal Reserve System (1999, p. 47.)

[26]This proxy will also detect the risk reduction typically achieved by greater diversification at larger firms.

the capital structure of a firm at the time that an issuance decision is made is likely to determine whether bond issuance would increase its market value. To account for differences in capital structure across banking organizations, the ratio of book equity to book total assets (*K/A*) was included in the issuance decision model. When this ratio is large, tax benefits from debt issuance are likely to outweigh the increased risk of bankruptcy and agency costs resulting from increased leverage, but this is less likely to be the case when *K/A* is small. Therefore, the rise in bankruptcy and agency costs associated with increased leverage suggests that debt issuance activities would be positively correlated with *K/A*.

Lastly, supervisors of a banking organization could potentially pressure its management to raise regulatory capital. To consider whether such pressure may have led some banking organizations to issue subordinated debt, we included two indicator variables. The first, *BOPEC2*, equals one if the composite supervisory rating equaled 2, and zero otherwise. The second, *BOPEC345*, equals one if the composite supervisory rating equaled 3, 4, or 5, and zero otherwise. Banking organizations with a composite supervisory rating of 1 or 2 are considered the safest and most well-managed institutions by supervisors. But, banking organizations with composite supervisory ratings of 3, 4, or 5 have moderate to substantial deficiencies that were uncovered during the examination process. Therefore, we would expect that banking organizations with composite supervisory ratings of 3, 4, or 5 would be under some pressure to improve their total regulatory capital, which includes subordinated debt after implementation of the Basel Accord.

Incorporating the variables used to proxy for (1) the current and prospective financial condition of the organization, $E[FC_{it}]$; (2) general business conditions, BC_t,; (3) factors that determine firm-specific benefits and costs associated with debt issuance, OF_{it}; and (4) the amount of supervisory pressure, SP_{it}, into equation (1), the decision to issue subordinated debt can be represented by

$$ISSUE_{it} = h([\, NATA_{it}, PDTA_{it}, OREO_{it}, AGAP_{it}, MKTLEV_{it}], [UE_t, XR_t, MKTVOL_t], \\ [ISSUE_{i,t-1}, \ln(ASSET_{it}), AVGTAX_{it}, K/A_{it}], [BOPEC2_{it}, BOPEC345_{it}]). \quad (2)$$

It is assumed that h(.) is linear in all of the variables.[27] This yields the following specification,[28]

$$\begin{aligned} ISSUE_{it} = \beta_0 &+ \beta_1 NATA_{it} + \beta_2 PDTA_{it} + \beta_3 OREO_{it} + \beta_4 AGAP_{it} + \beta_5 MKTLEV_{it} \\ &+ \beta_6 UE_t + \beta_7 XR_t + \beta_8 MKTVOL_t + \beta_9 ISSUE_{i,t-1} + \beta_{10} \ln(ASSET_{it}) \\ &+ \beta_{11} AVGTAX_{it} + \beta_{12} K/A_{it}\, \beta_{13} BOPEC2_{it} + \beta_{14} BOPEC345_{it}. \end{aligned} \tag{3}$$

where the expected signs of parameters for the risk measures (*NATA*, *PDTA*, *OREO*, *AGAP*, and *MKTLEV*) are negative; expected signs of the parameters for business conditions (*UE, XR,* and *MKTVOL*) are negative; expected signs of the parameters for banking-organization-specific factors ($ISSUE_{t-1}$, ln (*ASSETS*), *AVGTAX*, and *K/A*) are positive; and, expected signs of parameters for supervisory pressure (*BOPEC2* and *BOPEC345*) are positive.

To estimate equation (3), we use standard latent variable techniques and treat the decision to issue as a continuous unobserved variable representing the probability that a banking organization issues subordinated debt. These techniques imply,

$$\begin{aligned} Prob(ISSUE_{it} = 1) = \Phi[&\beta_0 + \beta_1 NATA_{it} + \beta_2 PDTA_{it} + \beta_3 OREO_{it} + \beta_4 AGAP_{it} + \beta_5 MKTLEV_{it} \\ &+ \beta_6 UE_t + \beta_7 XR_t + \beta_8 MKTVOL_t + \beta_9 ISSUE_{i,t-1} + \beta_{10} \ln(ASSET_{it}) \\ &+ \beta_{11} AVGTAX_{it} + \beta_{12} K/A_{it}\, \beta_{13} BOPEC2_{it} + \beta_{14} BOPEC345_{it}.] \end{aligned} \tag{4'}$$

and

$$Prob(ISSUE_{it} = 0) = [\, 1 - Prob(ISSUE_{it} = 1) \,]. \tag{4"}$$

where Φ is the standard normal cumulative distribution function. This probit model was estimated

[27]For continuous right hand side variables, the average value for a two quarter interval is used, and for binary right hand side variables, the average of the appropriate underlying variable over two quarters is used. The left hand side variable is set equal to one if the bank issues in a two quarter period and zero otherwise. To enhance the exogeneity of the right hand side variables, explanatory variables are lagged by one quarter.

[28]Based on Flannery and Sorescu (1996) we also considered a more general specification in which all of the accounting risk measures, except MKTLEV, were interacted with MKTLEV and $MKTLEV^2$. The empirical results from this more general specification were consistent with those of the linear specification described in the text with similar conclusions about market discipline.

using quarterly data for top fifty U.S. bank holding companies [29] for four regulatory regimes: (1) the "*de jure* protection" (1986-1987) regime; (2) the "purchase and assumption" (1988-1992) regime; (3) the pre-FDICIA (1986-1992) regime; and, (4) a post-FDICIA (1993-1999) regime.

III. A SAMPLE SELECTION MODEL FOR OBSERVED ISSUANCE SPREADS

The previous discussion suggests that issuance spreads are likely to depend on the issuing banking organization's financial condition, size, and frequency of coming to the market, on systematic risks, and on the characteristics of the instrument that is issued. As with the issuance decision model, we measure the financial condition of banking organization *i* by the ratio of non-accruing loans to total assets ($NATA_{it}$), the ratio of accruing loans past due 90 days or more to total assets ($PDTA_{it}$), the ratio of other real estate owned to total assets ($OREO_{it}$), the absolute value of the difference between assets and liabilities maturing or repricing within one year as a proportion of equity value ($AGAP_{it}$), and the ratio of total book liabilities to the sum of the market value of common stock and the book value of preferred stock ($MARKETLEV_{it}$). Bank size is again measured by ln(*ASSET*) and the frequency of issuance is proxied by $ISSUE_{i,\,t-1}$.

Investors may require a risk premium to compensate for systematic, rather than diversifiable, risk.[30] Several researchers have demonstrated that corporate bond returns vary systematically with the same factors (e.g., excess stock returns) that are commonly accepted as explaining risk premiums for common stocks.[31] Moreover, time-series models for secondary subordinated debt spreads for large U.S. banking organizations suggest that such spreads are correlated with excess stock returns.[32] Hence, a quarterly excess stock return constructed from the Center for Research in Security Prices'

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[29]In each quarter, the top 50 BHCs were defined as those organizations that were among the largest 50 when such organizations are ranked by asset size using holding company "Y Reports" submitted to the Federal Reserve. Thus, the top 50 BHCs can be different in each quarter. Most, but not all, top 50 BHCs have some publicly issued subordinated debt outstanding. Bond issues by top 50 BHCs were identified using Standard & Poor's Master CUSIP Directory.

[30]Elton, Gruber, Agrawal and Mann (2001) argue that corporate bond spreads could move systematically with other assets in the market because (1) expected default losses could be correlated with equity prices (i.e., default losses could decline with a rise in stock prices and default losses could increase with a fall in stock prices); and, (2) the compensation for risk required in capital markets could change over time.

[31]See Fama and French (1993) and Elton, Gruber, Agrawal, and Mann (2000).

[32]See Hancock and Kwast (2001).

daily value-weighted return on NYSE, Amex, and Nasdaq stocks and daily one-month Treasury bill rates, *XR*, is included in our observed issuance spread model.[33]

Table 1 presents instrument characteristics (e.g., imbedded call options, maturity lengths, and coupon frequency) for the subordinated notes and debentures that were issued by top 50 bank holding companies during the 1987-1999 period. Fixed-rate, non-callable, semi-annual coupon, long-term (10 to 20 year) bonds were the most commonly issued instruments during the sample period, particularly among issues in amounts greater than $75 million. By and large, issues of the 20 largest bank holding companies tended to be more standardized than were issues of smaller bank holding companies.[34] And, larger holding companies were more likely to issue subordinated debt with a larger issue size.[35]

In principle, the value of a call option is always non-negative. This means that the "raw" calculated subordinated debt spread *overestimates* the default risk premium.[36] An indicator variable, *CALL*, that equals one when an issue has a call option, and that equals zero otherwise, is included in the regression equation for observed issuance spreads. Since call options are always non-negative, it is expected that the sign on *CALL* would be positive.[37] Interestingly, the percentage of new subordinated debt issues that are callable varies considerably across time for top 50 banking organizations (table 1).

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[33]The daily excess stock return is calculated as the difference between the daily value-weighted return on NYSE, Amex, and Nasdaq stocks and the off-the-run one month Treasury return. The quarterly excess stock market return is the quarterly average of daily excess stock market returns.

[34]See Board of Governors of the Federal Reserve System and U.S. Department of the Treasury (2000, pp. 9-13).

[35]During the decade of the 1990s, the average size of a debt issue for the 20 largest bank holding companies more than doubled. Over the same period, the average size of a debt issue for the next 30 largest bank holding companies fluctuated around $200 million, despite the fact that the largest issue in some years was made by a holding company in that group.

[36]The value of a bond's call option increases with its maturity and the volatility of market interest rates, and decreases with the required call premium. See Avery, Belton, and Goldberg (1988), Gorton and Santomero (1990), and Flannery and Sorescu (1996) for a discussion about computing option-adjusted spreads. Alternatively, Boardman and McEnally (1981) used a net present value calculation for deciding when to call an issue in their analysis of the factors that affect seasoned corporate bond prices.

[37]A negative or zero coefficient on the call option indicator variable would imply that debt holders did not value the call option appropriately.

In addition, it may be the case that bonds with non-standard maturities are less liquid than are bonds with standard maturities.[38] If true, then bonds with non-standard maturities would have larger spreads, *ceteris paribus*. To capture non-standard maturity effects on spreads, an indicator variable for bonds issued with a maturity less than 10 years, *MATLT10,* and an indicator variable for bonds issued with a maturity greater than 20 years, *MATGT20* was included in the issuance spread regression.[39] Each of these indicator variables equals one for the specified maturity range, and zero otherwise. Since non-standard maturities are expected to raise spreads, it is expected that the sign on these maturity indicator variables would be positive.

It also seems reasonable that coupon frequency could affect the types of investors willing to purchase an issue. Presumably, higher coupon frequency (e.g., monthly coupon payments) would attract smaller "retail" investors, and the resulting higher demand would lower the issuance spread. To capture this potential effect on the subordinated debt spread, we include two indicator variables, *COUPON12* and *COUPON2,* that equal one when the coupon frequency is monthly and semi-annually, respectively, and that equal zero otherwise. Our reasoning suggests that the coefficients on the monthly coupon frequency indicator will be negative. Interestingly, there appears to be a recent trend toward paying coupons more frequently (table 1).

Because smaller issues tend to rapidly get absorbed into investor portfolios, such issues tend to be less liquid in the secondary market.[40] For this reason, smaller issues are more difficult and expensive to sell to institutional investors.[41] Therefore, it is expected that issuance spreads are likely to be negatively correlated with issuance size (*ISSUESIZE*).

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[38]Non-standard maturity instruments may be issued by banking organizations to match the duration of their liabilities with the duration of their assets, or these instruments may be issued when an organization wants to attract funds from small retail investors.

[39]Maturities and other instrument characteristics for each subordinated bond were identified using Moody's Default Risk Service data base, Fitch Investment Securities Database, Warga and Bloomberg data bases as well as monthly issues of *Mergent Bond Record* over the January 1984-December 2001 period, inclusive.

[40]Hancock and Kwast (2001) present histograms of weekly subordinated debt spread discrepancies between Bloomberg and Interactive Data Corporation pricing data sources over the January 1997 to October 1999 period for bonds stratified by issuance size. The tightest distribution of spread discrepancies is for bonds with issuance sizes greater than $300 million. The next tightest distribution was for bonds with issuance sizes between $100 million and $300 million. And, the widest distribution was for bonds with issuance sizes less than $100 million. The decreased dispersion in spread discrepancies for larger issues suggests that there may be a positive correlation between the flow of trade in a particular bond and its amount outstanding at issuance.

[41]See Board of Governors of the Federal Reserve System (1999, p. 46.)

Since issuance spreads are only observed for those bank holding companies that actually chose to issue subordinated debt, a sample selection model is used to analyze such spreads. Consistent estimates of the sample selection model are obtained using Heckman's two-stage method.[42] This method involves estimating the issuance decision equation with probit (described above), and then using the inverse Mills ratio function of the probit residuals as an extra variable in a regression for the observed issuance spreads.[43]

To sum up, the regression estimated for observed issuance spreads over Treasury securities with comparable maturities is:[44]

$$\begin{aligned} SPREAD_{it} = \alpha &+ \beta_1 NATA_{it} + \beta_2 PDTA_{it} + \beta_3 OREO_{it} + \beta_4 AGAP_{it} + \beta_5 MKTLEV_{it} \\ &+ \beta_6 ISSUE_{i,t-1} + \beta_7 \ln(ASSET_{it}) + \beta_8 XR_t \\ &+ \beta_9 CALL_{it} + \beta_{10} MATLT10_{it} + \beta_{11} MATGT20_t \\ &+ \beta_{12} COUPON12_{it} + \beta_{13} COUPON2_{it} \\ &+ \beta_{14} ISSUESIZE + \beta_{15} MILLSRATIO_{it} \end{aligned} \tag{5}$$

Each observed $SPREAD_{it}$ was calculated from observed bond prices using derived yields on each bond calculated by the Newton-Ralphson iterative method and an interpolated Treasury yield of the same maturity.[45] This sample selection model allows for consideration of whether issuance spreads are sensitive to bank-specific risks, to systematic risk, and to instrument characteristics (e.g., issuance size).

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[42]See Heckman (1974) for a discussion of this two-step method for sample selection models.

[43]Since the conventionally estimated standard errors and associated t-statistics are not consistent estimates for the regression for observed issuance spreads, it was necessary to compute heteroskedastic-consistent standard errors. The heteroskedastically consistent t-statistics, computed using White (1980), are reported below.

[44]A nonlinear specification for the risk variables, similar to that estimated by Flannery and Sorescu (1996), was also estimated. This specification yielded results that were qualitatively similar to the more straightforward to interpret linear specification reported.

[45]Issuance prices were obtained from the Bloomberg "generic" bond pricing series, which is constructed using the consensus method that averages observed *trading prices* after dropping the highest and lowest observations. For the consensus method, a minimum of three observations is required, after dropping the highest and lowest observations, for a price to be valid, otherwise a missing value is entered for the trading price. Valid prices were obtained on all issuance dates. The term structure of Treasury interest rates was identified on each trading price issuance date by using a smoothing spline of the forward rate curve that incorporates a "roughness" penalty determined by generalized cross validation. This splining technique is described in Fisher, Nychka, and Zervos (1994).

IV. EMPIRICAL RESULTS

The issuance decision and issuance spread models were estimated using quarterly data. Table 2 presents parameter estimates for the issuance decision probit model, equation (4), in the left panel, and for the observed issuance spreads sample selection model, equation (5), in the right panel. Within each of these panels, estimates are presented for four regulatory regimes: (1) the "*de jure* protection" (1986-1987) regime; (2) the "purchase and assumption" (1988-1992) regime; (3) the pre-FDICIA (1986-1992) regime; and, (4) a post-FDICIA (1993-1999) regime. Parameter estimates with the expected sign are indicated with an "X," and t-statistics are in parentheses.

Importantly, the parameter estimates for the inverse Mills ratio, which are presented in the bottom right panel of table 2, are significant at a 5 percent level in the 1988-1992 period, in the pre-FDICIA (1986-1992) period, and over the entire post-FDICIA (1993-1999) time frame. These significant parameter estimates not only confirm the importance of adjusting for sample selection bias, but also underscore the relevance of taking into account funding manager issuance decisions when considering the risk-sensitivity of subordinated debt spreads. If only issuance spreads were considered without taking into account the sample selection that is generated when funding managers time their debt issues, then risk-sensitivity estimates for such spreads would be biased. This is the case even when issuance decisions are not sensitive to banking organization-specific risks since there is some correlation between banking organization-specific risks and other variables (e.g., bank size and stock market excess returns) that are included in the issuance decision model. In addition, the significant *positive* coefficient on this ratio provides evidence that the surprise component of the issuance decision was positively correlated with the surprise component on subordinated debt spreads during three of the four deposit insurance regimes that we considered. This positive correlation suggests that some large banking organization issuers were forced to issue subordinated debt at a surprisingly high spread.[46]

A. THE *DE JURE* PROTECTION (1986-1987) REGIME

Most observers believe that subordinated debt investors exerted very little market discipline on U.S. banking organizations during the mid-1980s. This view has been buttressed by a lack of evidence that investors were pricing subordinated debentures in relation to perceived bank risks

[46]See Flannery and Houston (1999, p. 26) for a discussion about interpreting the significance of the sign of the coefficient on the inverse Mills ratio.

during that period. For example, studies by Avery, Belton, and Goldberg (1988), Gorton and Santomero (1990), and Flannery and Sorescu (1996) were unable to detect significant correlations between bank-specific risk measures and either secondary market subordinated debt spreads, or implied asset volatilities derived from such spreads, during the 1984-1985 period. When Flannery and Sorescu included 1986 data with their 1984-1985 sample, they were only marginally able to reject (at the 10 percent confidence level) the hypothesis that their risk measures did not influence subordinated debt spreads. But, this sensitivity to risk, albeit weak, was apparently short-lived, since Flannery and Sorescu found even less impact of accounting risk measures on spreads in the 1986-1988 period.[47]

In contrast, other research suggests that investors in large certificates of deposit exerted significant market discipline on large U.S. banking organizations in the mid-1980s. Many studies (e.g., Hannon and Hanweck (1988), James (1988, 1990), Keeley (1990), and Ellis and Flannery (1992)) that used a variety of data sources, risk metrics, and empirical techniques concluded that these uninsured liabilities were priced to reflect bank risks, even for banking organizations perceived to be "too-big-to-fail."[48]

The asymmetry between the debt and certificate of deposit market results have proved difficult to interpret. In principle, one would expect subordinated debt holders to be *more* sensitive to bank risks than uninsured depositors because the former liability holders have *less* access to the public safety net than the latter, and are otherwise further down the list of payments in the event of failure.

One reason why it may have been difficult to statistically detect market discipline in the mid-1980s is the insensitivity of funding manager issuance decisions to bank-specific risks. In the leftmost column of table 2, it is readily apparent that none of the financial condition parameter estimates in the issuance decision model are statistically significant. Moreover, the five risk measures taken together did not have a significant effect on funding manager issuance decisions -- a Wald test of the restriction that all risk measure coefficients are zero was not significant at the 5 percent confidence level (table 2, bottom panel). Because bank-specific risks did not play a major

[47]See Flannery and Sorescu (1996, pp. 1364-1365).

[48]See Board of Governors of the Federal Reserve System and U.S. Department of Treasury (2000, pp. 70-76) for a summary of empirical studies on the effectiveness of market discipline exerted by uninsured liabilities on banking organizations.

role in determining the timing of issuance decisions for subordinated notes and debentures in the mid-1980s, the age of outstanding instruments did not systematically depend on the financial condition of banking organizations. Liquidity premiums on outstanding instruments that built up when firms did not issue subordinated debt may have been large and sufficiently random to make it quite difficult to detect the true underlying relationship between secondary market spreads and bank-specific risks.

Next, consider the observed issuance spread sample selection model estimates for the 1986-1987 period (first column, right panel, table 2). Although none of the financial condition parameter estimates are individually statistically significant, the estimates for *PDTA*, *OREO*, and *MKTLEV* are of the expected sign. Most importantly, taken together, the five risk measures had a significantly positive effect on issuance spreads in 1986-1987 -- the Wald test statistic for this joint test is 29.03, which is considerably above the critical value of 11.1 for the five percent level of confidence. These findings are consistent with primary market subordinated debt investors pricing subordinated debentures in relation to perceived bank risks, and are also consistent with the risk-sensitive spreads on large certificates of deposit reported in previous studies.

Other banking organization-specific factors largely influenced issuance decisions and observed spreads in the expected manner during the *de jure* regulatory regime. Larger banks were more likely to issue subordinated debt, despite the fact that their size did not reduce their issuance spread once bank-specific risks were accounted for. The frequency of issuance indicator variable parameter estimate had the expected sign in both the issuance decision and the spread models, but neither estimate was statistically significant. Only the capital structure variable (*K/A*) in the issuance decision model had an unexpected sign, so that more highly capitalized firms were statistically less likely to issue subordinated debt.

It was also the case that business and bond market conditions influenced subordinated debt issuance decisions in the expected manner during the *de jure* regulatory regime. Increased stock market returns and bond market volatility significantly reduced the likelihood that large banking organizations issued debt during the 1986-1987 period. But, issuance spreads were not statistically correlated with excess stock market returns.

It does not appear that bank supervisors were pressuring banks to issue subordinated debt over 1986-1987. The weakest banking organizations from a supervisory viewpoint (i.e., those with a supervisory rating equal to 3, 4 or 5), were not significantly compelled to issue subordinated debt.

And, banking organizations considered safe and well-managed institutions by bank supervisors, with a composite supervisory rating of 2, were the least likely to issue subordinated debt.

Instrument characteristics were important determinants of issuance spreads during the 1986-1987 period. Interestingly, call options did not significantly affect such spreads. However, atypically long maturities significantly increased issuance spreads and atypically frequent coupon payments significantly reduced such spreads.

B. THE "PURCHASE AND ASSUMPTION" (1988-1992) REGIME

During the late 1980s and early 1990s, bank regulators made it increasingly clear that subordinated debt investors were not protected by the safety net. With the implementation of purchase and assumption transactions, several financial institution failures (e.g., First Republic (July 1988), Bank of New England (January 1991) and Southeast Banking Corporation (September 1991)) resulted in losses sustained by investors in subordinated claims issued by their parent holding companies.

The increased resolve by bank regulators apparently did not substantially increase the risk-sensitivity of issuance decisions, but did increase the risk-sensitivity of issuance spreads. In the 1988-1992 period, as in the 1986-1987 period, none of the five bank-specific financial condition parameter estimates is statistically significant in the issuance decision model and these five risk measures were not jointly statistically significant at the usual significance levels.[49] Although none of the parameter estimates on these financial condition measures was significant in the issuance spread model during 1986-1987, this was not the case during 1988-1992: The parameter estimates on *OREO* and on *MKTLEV* are not only of the expected (positive) sign, they are also statistically significant with large t-statistics. Moreover, the five bank financial condition parameter estimates together are positive and significantly different from zero (bottom panel, table 2).

During 1988-1992, larger banking organizations and frequent issuers were more likely to issue subordinated debt, holding all else equal. But, size and frequency of issuance did not reduce issuance spreads. Indeed, after controlling for banking organization-specific risks, frequent issuers typically paid higher, rather than lower, issuance spreads.

Business and bond market conditions did not materially affect issuance decisions during the

[49]The Wald test of the restriction that all risk measure coefficients are zero was not significant at the 5 percent confidence level (bottom panel, table 2).

purchase and assumption period. Even though the parameter estimates for stock market excess returns and bond market volatility were significant in the 1986-1987 period, such estimates were insignificant in the 1988-1992 period. And, unemployment did not affect issuance decisions in either of these two periods.

Banks in each supervisory rating group were equally likely to issue subordinated debt during the 1988-1992 period. Parameter estimates on both *BOPEC2* and *BOPEC345* were insignificant and neither estimate had the expected sign.

Although we considered many different potential effects of instrument characteristics on issuance spreads, only the semi-annual coupon indicator variable parameter estimate was significant in the purchase and assumption period. As in the 1986-1987 period, call options did not statistically increase the spreads paid on banking organization subordinated debentures. Unlike the 1986-1987 period, instruments with atypically long maturities did not have significantly higher issuance spreads.

C. THE "PRE-FDICIA (1986-1992) REGIME

Although issuance decisions did not depend on organization-specific financial conditions during the pre-FDICIA (1986-1992) regime, issuance spreads were sensitive to such conditions in the expected manner. None of the financial condition parameter estimates in the issuance decision model were individually significant (top left panel, table 2), nor were they significant together (bottom left panel, table 2). In contrast, parameter estimates in the issuance spread model for *OREO* and *MKTLEV* were significant and of the expected sign (top right panel, table 2) and the five risk variables together were significant and of the expected sign (bottom right panel, table 2).

In this pre-FDICIA regime, larger organizations and more frequent issuers tended, *ceteris paribus*, to be more likely to issue subordinated debt. In fact, the parameter estimates on ln(*ASSET*) and $ISSUE_{t-1}$ are both positive and statistically significant (left panel, table 2). Although organization size significantly influenced issuance spreads in the pre-FDICIA regime, more frequent issuers did not have statistically different issuance spreads from less frequent issuers (right panel, table 2). Because larger banks had significantly larger issuance spreads than smaller banks did, it was not a lower spread that made larger banks more likely to issue subordinated debt during the pre-FDICIA regime.

Bond market conditions, measured by (*MKTVOL*), significantly influenced issuance decisions in the pre-FDICIA regime (left panel, table 2), but business conditions, measured by the

unemployment rate (*UE*) and stock market excess returns (*XR*), did not significantly influence such decisions. Moreover, stock market excess returns (*XR*) did not significantly influence issuance spreads during this regime.

By and large, parameter estimates for instrument characteristics (bottom right panel, table 2) were of the expected sign in the pre-FDICIA period, at least when such estimates were statistically significant. Bonds with atypically short maturities tended to have higher spreads: The parameter estimate on *MATLT10* is positive and significant. And, bonds that paid coupons semi-annually tended to have higher spreads than those that paid coupons quarterly (i.e., the parameter estimate on *COUPON2* is positive and statistically significant). Although relatively large issues tended to have lower spreads, which was expected, a issue size effect was not statistically significant in the pre-FDICIA period. Perhaps this result should have been expected, since new issues tend to be liquid, regardless of their size.

D. THE "POST-FDICIA (1993-1999) REGIME

In theory, the deposit insurance reforms of the early 1990s could have either increased or reduced the risk-sensitivity of banking organization issuance decisions and subordinated debt yields. The application of least cost resolution methods and the lowered liquidation standing of bank subordinated debt were reforms that made it more likely that subordinated investors would incur losses in the event of a bank failure. But, the implementation of prompt corrective actions could potentially reduce regulatory forbearance and thereby reduce the exposure to losses that is held by subordinated debt investors.[50] Such reforms would also influence expected financial distress costs and default probabilities for U.S. banking organizations.

Empirically, deposit insurance reforms in the early 1990s are estimated to have increased the risk-sensitivity of issuance decisions, but not increased the risk-sensitivity of issuance spreads. As in the pre-FDICIA period, none of the parameter estimates for financial condition variables is individually significant in the issuance decision model (top left panel, table 2) in the post-FDICIA period. In fact, only two of the five parameter estimates on these risk proxies had the expected (negative) sign. Taken together, however, the five financial condition measures had a significant *negative* effect on the issuance decision (bottom left panel, table 2): The Wald statistic equaled

[50]The system of prompt corrective action is similar to an early default bond covenant. Such covenants tend to lower spreads (Black and Cox (1975)) holding other things constant.

11.42, which is above the 11.1 critical value for the five percent level of confidence. This finding indicates that riskier banking organizations were *less likely* to issue subordinated debt than less risky banking organizations, *ceteris paribus,* during the post-FDICIA period. Importantly, this relationship between bank-specific risks and funding manager issuance decisions was not statistically detected in the pre-FDICIA period.

Parameter estimates on financial condition variables in the issuance spread model estimated with post-FDICIA data usually have the expected (positive) sign and the estimates on *PDTA* and *MKTLEV* are statistically significant as well. Taken together, the five risk measures had a significant and positive effect on the issuance spread (bottom right panel, table 2). In addition, these risk variables together had about the same-sized positive effect (5.4 at the sample mean) on the issuance spread during the post-FDICIA period as said variables together had on the issuance spread during the pre-FDICIA period (5.04 at the sample mean). Importantly, this finding implies that once the issuance decision in controlled for, issuance spreads were about as risk-sensitive in the post-FDICIA period as they were during the pre-FDICIA period.

Size and frequency of issuance mattered when issuance decisions were made in the post-FDICIA period. These variables also influenced issuance decisions in the pre-FDICIA period. And, the firm's tax rate and capital structure were not important determinants of issuance decisions in either the pre- or post-FDICIA periods. Also common to both of these two periods was the finding that larger organizations tend to have higher, rather than lower, spreads after controlling for bank-specific risks and other factors.

The post-FDICIA regime was the only regime we considered where the unemployment rate statistically influenced issuance decisions (left panel, table 2). Curiously, however, subordinated debt issuance by large U.S. banking organizations was more likely when the unemployment rate was relatively high. Because the unemployment rate was at its highest level during the implementation period for the Basel Accord, it is likely that this explanatory variable is negatively correlated with many banking organization's need to raise regulatory capital. The other business and bond market condition variables (i.e., *XR* and *MKTVOL*) that were considered did not statistically influence issuance decisions in the post-FDICIA period. Moreover, in the sample selection model (right panel, table 2) panel, table 2) excess stock returns did not statistically impact issuance spreads.

Most of the instrument characteristics that were considered influenced post-FDICIA spreads in the expected manner. Issues with call options had statistically higher spreads than those without.

Issues with atypically short maturities had statistically higher spreads than those with more typical maturities. And, issues with monthly or semi-annual coupon frequency had statistically higher spreads than did issues with quarterly pay-outs. Contrary to popular wisdom, larger issue sizes paid higher spreads than smaller issue sizes holding bank-specific risks, other bank factors, business and bond market conditions constant. Of course, larger-sized issues in the secondary market could have lower spreads, since such issues tend to be more liquid (Hancock and Kwast (2000)), even though issuance spreads, which are less affected by liquidity premiums, are larger.

V. MARKET DISCIPLINE IN BANKING RECONSIDERED

Traditionally, researchers have used the risk sensitivity of secondary market prices for banking organization subordinated debt as a barometer for the potential of market discipline to effectively and constructively augment regulatory and supervisory controls for bank risk-taking. Our results challenge this conventional wisdom, and suggest that secondary market prices may understate the potential of market discipline in some periods and overstate it in others because liquidity premiums contained in secondary spreads depend in part on funding manager issuance decisions and such decisions are sensitive to the design of safeguards that limit the size of the safety net.[51]

The sensitivity of secondary spreads to bank-specific risks can *understate* the potential for market discipline when funding manager issuance decisions are independent of the risk factors that investors use to calibrate default risks. We find this to have been the case in the 1986-1987 period, the 1988-1992 period, and the overall pre-FDICIA time frame considered here. Importantly, this implies that liquidity premiums, which are contained in the secondary spreads of subordinated debt issues that were outstanding during that time period, were also not systematically related to the organization-specific risks that were analyzed. Debt of *both* risky and safe firms that continued to issue had relatively low liquidity premiums, while debt of *both* risky and safe firms that delayed issuing built up relatively large liquidity premiums. Thus, observed secondary spreads contained essentially random (from an organization-specific risk-perspective) liquidity premiums that generated "noise." In the presence of such noise, it is perhaps not surprising that many studies could

[51]Although our evidence regarding secondary market spreads is indirect because we use primary market data, we believe it is highly suggestive. Still, more research on the secondary market debt spreads is needed to ascertain more precisely how the timing of funding manager issuance decisions affect such spreads.

not detect any correlation between secondary market subordinated debt spreads and accounting- or market-based measures of financial condition during the mid-1980s. Moreover, it is also perhaps not surprising that it became easier to detect the risk-sensitivity of such spreads when overall bond market liquidity increased during the early 1990s.[52]

In contrast to existing results that use secondary market prices, we find that "on-the-run" subordinated debt issuance spreads were sensitive to these same risk proxies in the 1986-1987 period, the 1988-1992 period, and over the entire pre-FDICIA time frame. The five risk-proxies we considered -- the ratio of non-accruing loans to total assets, the ratio of accruing loans past due 90 days or more to total assets, the ratio of other real estate owned to total assets, the absolute value of the difference between assets and liabilities maturing or repricing within one year as a proportion of equity value, and the ratio of total book liabilities to the sum of the market value of common stock and the book value of preferred stock -- significantly influenced issuance spreads in the expected manner. Moreover, consistent with the findings of the studies that considered the risk-sensitivity of secondary market prices, we find that the risk-sensitivity of issuance spreads increased as bank regulators made it increasingly clear that subordinated debt investors were not protected by the safety net.

When issuance decisions depend on the same risk factors that investors use to calibrate default risks, the sensitivity of secondary spreads to bank-specific risks can *overstate* the potential for market discipline. In the post-FDICIA period, we estimate that funding manager issuance decisions for subordinated debt in fact became sensitive to the same organization-specific risks that had always affected issuance spreads. That is, subordinated debt was more likely to be issued by relatively safe banking organizations and less likely to be issued by relatively risky banking

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[52]It is well-known among market participants that bond market liquidity has generally increased over the past decade. Consistent with this view, using data for the New York Stock Exchange (NYSE), Chordia, Roll and Subrahmanyam (2001) have constructed time-series indices of market-wide liquidity measures (e.g., quoted and effective bid-ask spreads) and market-wide trading activity (e.g., the volume and number of daily transactions) over the eleven-year period 1988-1998, inclusive. They demonstrate that there was a secular downward trend in average quoted and effective bid-ask spreads (with a fairly steep decline in these measures in the late 1980s and early 1990s) and an upward trend in depth and volume for NYSE-listed stocks. These trends are consistent with an increase in aggregate stock market liquidity, particularly during the late-1980s and early-1990s. Using similar liquidity measures for the government bond market (e.g., quoted and effective bid-ask spreads), Chordia, Sarkar and Subrahmanyam (2002) have considered the joint time-series of daily liquidity in bond and stock markets over the 1991 to 1998 period. They report that innovations in liquidity are positively and significantly correlated across stock and bond markets. Together, the findings of Chordia, Roll and Subrahmanyam (2001) and Chordia, Sarkar, and Subrahmanyam (2002) are consistent with an increase in overall bond market liquidity during the late-1980s and early-1990s.

organizations. Consequently, observed secondary spreads on outstanding issues were lower for relatively safer banking organizations both because the default risk component of the spread was smaller and also because the liquidity premium was smaller for these banking organizations, compared to relatively risky banking organizations. Again, liquidity premiums fell for relatively safe banks that continued to issue, but rose for relatively risky banks that delayed or even stopped issuing subordinated debt. Because liquidity premiums boost the sensitivity of secondary market spreads to organization-specific risks when issuance decisions are sensitive to such risks, it may appear that investors have become more risk-sensitive when in fact they have not. Indeed, after controlling for such factors, we find that issuance spreads remained about as sensitive to risks in the post-FDICIA period as they had been in the pre-FDICIA period.[53]

The foregoing interpretations suggest that regulatory reforms tailored to limit the size of the safety net can not only augment market discipline, but may also make it more difficult to detect changes in market discipline. Reforms aimed at increasing the losses borne by holding company subordinated debt holders in the event that their firm's subsidiary financial institutions fail may succeed at increasing the risk-sensitivity of subordinated debenture prices, but such increases may be difficult to detect in the presence of large and random liquidity premiums.

In addition, regulatory reforms tailored to limit the size of the safety net may also make it more difficult to use signals from the secondary market as a "lever to strengthen the safety and soundness of the banking system."[54] Reforms aimed at increasing the costs of financial distress, while inducing banking organizations to behave more like other corporate entities, may not only affect the credit-risk-sensitivity of debenture prices, but also increase the sensitivity of issuance decisions to organization-specific risks, systematic risks, and business conditions. In this case, the sensitivity of issuance decisions to risk factors makes it difficult for market participants and for bank

[53]Although investors focused their attention on different risk proxies in these two periods (i.e., different parameter estimates are significant in the two rightmost panels of table 2), they weighed the risks so as to remain on average equally sensitive to banking organization-specific risk measures.

[54]Proponents of using secondary debt market signals to initiate prompt corrective actions or to otherwise reduce regulatory forbearance include Calomiris (1997), U.S. Shadow Regulatory Committee (2000), and Evanoff and Wall (2000). Board of Governors of the Federal Reserve System and United States Department of the Treasury (2000) contains a summary of mandatory subordinated debt proposals. And, Board of Governors of the Federal Reserve System (1999) and Board of Governors of the Federal Reserve System and United States Department of the Treasury (2000) provide analyses of the effects of various features of a mandatory subordinated debt policy, including the hard-wiring of insolvency procedures, on operational feasibility, potential benefits, and potential costs.

supervisors to detect underlying organization-specific credit risk changes from either relative spreads, or changes in secondary spreads, because liquidity premiums now depend on these and other risks. Indeed, overreactions to changes in relative spreads are quite likely since the risk-sensitivity of observed secondary market spreads is magnified by the risk-sensitivity of issuance decisions.

Such conclusions suggest a role for mandatory subordinated debt not considered previously in the literature. Specifically, our findings suggest that a mandatory subordinated debt policy that would *exogenously* require large U.S. banking organizations to issue subordinated debt of a minimum issuance size on a regular basis could both potentially improve the information content of secondary market prices (i.e, improve market efficiency) and substantially improve market discipline. Such a policy would ensure that both risky and safe banks had "on-the-run" issues in the secondary market. Since adjustments for liquidity premiums on such instruments would depend largely on overall bond market liquidity, spreads would be more comparable across institutions and overreactions to changes in default risk would be less likely. In effect, by reducing the endogeneity of liquidity premiums, exogenous issuance requirements would boost the information content of secondary market subordinated debt prices. On-going improvements in bond market liquidity would reinforce such effects. As an added benefit, because some relatively risky banking organizations today choose not to issue subordinated debt when their financial condition is poor, forced regular issuance could substantially increase the funding costs that would be associated with risk-taking over and above those costs associated with not issuing subordinated debt. The anticipation of higher funding costs from increased risk would provide an incentive for the issuing organization to refrain from taking excessive risks, which implies an increase in market discipline. At the same time, because purchasers of subordinated debt need a clear picture of a banking organization's overall riskiness, required issuance of such debt would encourage transparency and disclosure by banking organizations. Such disclosure would, of course, boost the information content of debt instrument prices in the secondary market. As a result, better secondary market price signals would facilitate the use of such signals by market participants and supervisors to strengthen the safety and soundness of the banking system.

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Table 1
Characteristics of the Subordinated Notes and Debentures that were Issued by Top 50 Bank Holding Companies in Each Year (1987-1999)

Instrument Characteristics	Year												
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Call Option													
No	61%	33%	87%	100%	97%	100%	100%	35%	28%	43%	25%	31%	27%
Yes	39%	67%	13%	0%	3%	0%	0%	65%	72%	57%	75%	69%	73%
Maturity													
Less than 10 Years	0%	0%	0%	18%	11%	15%	2%	27%	31%	2%	0%	4%	0%
10 Years	21%	67%	47%	63%	64%	68%	65%	53%	24%	26%	33%	18%	40%
10-20 Years	75%	33%	47%	9%	19%	17%	31%	18%	39%	65%	61%	51%	55%
Greater than 20 Years	4%	0%	7%	9%	6%	0%	2%	2%	6%	7%	6%	27%	5%
Coupon													
Yes	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	95%	93%
Coupon Frequency													
Semi-annual	86%	67%	100%	100%	100%	96%	82%	48%	52%	46%	32%	55%	43%
Quarterly	4%	33%	0%	0%	0%	4%	18%	2%	0%	2%	6%	12%	10%
Monthly	11%	0%	0%	0%	0%	0%	0%	50%	48%	52%	62%	27%	40%
Rate													
Fixed	86%	100%	100%	100%	100%	96%	82%	98%	100%	97%	99%	95%	100%
Floating	14%	0%	0%	0%	0%	4%	18%	2%	0%	3%	1%	5%	0%
Amount Issued (in Millions of Dollars)													
Minimum	50	55	100	100	10	100	75	1	1	1	3	2	10
Maximum	300	300	400	200	750	500	600	500	443	500	493	601	1000
Mean	161	168	193	138	147	194	194	98	78	100	89	116	118
Median	175	150	200	119	100	200	200	11	25	23	20	25	33
Memo Item:													
Number of Subordinated Debt Issues per Annum	28	3	15	11	36	53	49	66	108	92	69	74	42

Table 2: Parameter Estimates for the Issuance Decision Model and the Sample Selection Model for Observed Subordinated Debt Spreads

(Large U.S Banking Organizations, Alternative Deposit Insurance Regulatory Regimes)

Explanatory Variables	Dependent Variable / Deposit Insurance Regime															
	Decision to issue								*Spread Over Treasury Securities with Comparable Maturities*							
	De Jure Protection 86:Q2-87:Q4	Expected Sign?	Purchase & Assumption 88:Q1-92:Q4	Expected Sign?	Pre-FDICIA Sample 86:Q2-92:Q4	Expected Sign?	Post-FDICIA Sample 93:Q1-99:Q4	Expected Sign?	De Jure Protection 86:Q2-87:Q4	Expected Sign?	Purchase & Assumption 88:Q1-92:Q4	Expected Sign?	Pre-FDICIA Sample 86:Q2-92:Q4	Expected Sign?	Post-FDICIA Sample 93:Q1-99:Q4	Expected Sign?
Financial Condition of the Banking Organization																
The ratio of non-accruing loans to total assets (NATA)	-7.591 (-0.38)	X	-10.770 (-1.43)	X	-9.739 (-1.46)	X	-4.630 (-0.31)	X	-48.974 (-1.11)		-8.610 (-1.39)		-25.254 (-2.69)		8.172 (1.44)	X
The ratio of accruing loans past due 90 days or more to total assets (PDTA)	-41.833 (-0.63)	X	-66.222 (-1.61)	X	-47.232 (-1.47)	X	10.466 (0.30)		39.115 (0.21)	X	-80.128 (-1.89)		-7.203 (-0.12)		44.450 (2.36)	X
The ratio of other real estate owned to total assets (OREO)	7.932 (0.15)		12.089 (0.74)		8.271 (0.55)		21.589 (0.68)		158.293 (1.49)	X	76.548 (5.20)	X	49.571 (2.23)	X	-16.291 (-1.16)	
The absolute value of the difference between assets and liabilities maturing or repricing within one year as a proportion of equity value (AGAP)	-0.045 (-1.35)	X	0.002 (0.59)		0.003 (0.84)		-0.029 (-1.06)	X	-0.263 (-1.94)		-0.001 (-0.16)	X	0.005 (0.77)	X	0.022 (1.17)	X
The ratio of total book liabilities to the sum of the market value of common stock and the book value of preferred stock (MKTLEV)	0.004 (0.09)		-0.017 (-0.64)	X	0.004 (0.18)		0.031 (0.91)		0.215 (1.55)	X	0.081 (5.46)	X	0.070 (2.28)	X	0.038 (3.07)	X
Other Banking Organization-Specific Factors																
The natural log of total assets (ln(ASSET))	0.660 (2.56)	X	0.639 (6.15)	X	0.645 (7.25)	X	0.697 (11.05)	X	1.164 (1.20)		0.286 (1.94)		0.652 (2.80)		0.215 (2.41)	
An indicator variable that equals one if the banking organization issued SND in the preceding 6 month period, and zero otherwise (ISSUE_-1)	0.613 (1.85)	X	0.461 (3.18)	X	0.464 (3.62)	X	0.703 (6.76)	X	-0.213 (-0.36)	X	0.349 (2.56)		0.319 (1.77)		0.170 (1.79)	
Foreign and domestic income taxes as a percentage of net income (AVGTAX)	0.002 (0.90)		-0.00004 (-0.04)		0.0001 (1.25)	X	0.0020 (0.69)	X	--		--		--		--	
The ratio of book equity to book total assets (KA)	-57.324 (-2.45)		-7.259 (-0.81)		-12.040 (-1.51)		-3.809 (-0.78)		--		--		--		--	

Table 2: Parameter Estimates for the Issuance Decision Model and the Sample Selection Model for Observed Subordinated Debt Spreads, continued

(Large U.S Banking Organizations, Alternative Deposit Insurance Regulatory Regimes)

Explanatory Variables	Dependent Variable / Deposit Insurance Regime															
	Decision to issue								*Spread Over Treasury Securities with Comparable Maturities*							
	De Jure Protection 86:Q2-87:Q4	Expected Sign?	Purchase & Assumption 88:Q1-92:Q4	Expected Sign?	Pre-FDICIA Sample 86:Q2-92:Q4	Expected Sign?	Post-FDICIA Sample 93:Q1-99:Q4	Expected Sign?	De Jure Protection 86:Q2-87:Q4	Expected Sign?	Purchase & Assumption 88:Q1-92:Q4	Expected Sign?	Pre-FDICIA Sample 86:Q2-92:Q4	Expected Sign?	Post-FDICIA Sample 93:Q1-99:Q4	Expected Sign?
Business and Bond Market Conditions																
The unemployment rate (UE)	1.073		0.458		0.458		0.696		--		--		--		--	
	(1.24)		(1.34)		(1.55)		(2.62)									
Stock Market Excess Return (XR)	-0.047		-0.007		-0.015		-0.018		-0.055		0.009		0.018		-0.0026	
	(-1.97)		(-0.71)		(-1.82)		(-2.42)		(-0.60)		(0.69)		(0.92)		(-0.32)	
The implied stock volatility measure calculated from option prices traded on the Chicago Board Option Exchange (MKTVOL)	-0.096		-0.029		-0.058	X	-0.002	X	--		--		--		--	
	(-3.22)		(0.96)		(-3.87)		(-0.09)									
Supervisory Pressure																
An indicator variable that equals one if the composite supervisory rating equals 2 (BOPEC2)	-0.740		0.178		0.008		-0.150		--		--		--		--	
	(-2.08)		(1.12)		(0.06)		(-1.42)									
An indicator variable that equals one if the composite supervisory rating equals 3, 4 or 5 (BOPEC345)	-0.517		-0.015		-0.233		0.022	X	--		--		--		--	
	(-1.02)		(-0.06)		(-1.20)		(0.06)									
Instrument Characteristics																
An indicator that equals one when an issue has a call option (CALL)	--		--		--		--		-0.518		-0.383		-0.878		0.328	X
									(-0.53)		(-0.58)		(-1.66)		(3.48)	
An indicator that equals one when an issue has a maturity less than ten years (MATLT10)	--		--		--		--		-0.355		0.115	X	0.259	X	0.152	X
									(-0.46)		(1.31)		(2.23)		(2.69)	
An indicator that equals one when an issue has a maturity greater than twenty years (MATGT20)	--		--		--		--		1.430	X	0.207	X	0.484	X	0.049	X
									(3.48)		(1.17)		(1.64)		(0.52)	
An indicator that equals one when the coupon frequency is monthly (COUPON12)	--		--		--		--		-1.910		--		--		0.830	
									(-2.04)						(3.94)	
An indicator that equals one when the coupon frequency is semi-annually (COUPON2)	--		--		--		--		1.772	X	2.036	X	1.765	X	0.957	X
									(1.76)		(10.17)		(3.57)		(4.33)	
The dollar amount of the issue (ISSUESIZE)	--		--		--		--		0.005		0.0003		-0.0003	X	0.0006	
									(1.07)		(0.62)		(-0.39)		(2.57)	

Table 2: Parameter Estimates for the Issuance Decision Model and the Sample Selection Model for Observed Subordinated Debt Spreads, continued

(Large U.S Banking Organizations, Alternative Deposit Insurance Regulatory Regimes)

Model Statistics	Dependent Variable / Deposit Insurance Regime															
	Decision to issue								*Spread Over Treasury Securities with Comparable Maturities*							
	De Jure Protection 86:Q2-87:Q4	Expected Sign?	Purchase & Assumption 88:Q1-92:Q4	Expected Sign?	Pre-FDICIA Sample 86:Q2-92:Q4	Expected Sign?	Post-FDICIA Sample 93:Q1-99:Q4	Expected Sign?	De Jure Protection 86:Q2-87:Q4	Expected Sign?	Purchase & Assumption 88:Q1-92:Q4	Expected Sign?	Pre-FDICIA Sample 86:Q2-92:Q4	Expected Sign?	Post-FDICIA Sample 93:Q1-99:Q4	Expected Sign?
Wald Tests																
Wald test statistic for "risk" coefficients jointly equalling zero	4.85		7.52		9.49		11.42		29.03		86.50		28.93		22.43	
Critical value for the Wald test at the 5 percent confidence level	11.1		11.1		11.1		11.1		11.1		11.1		11.1		11.1	
Mills Inverse Ratio																
Mills inverse ratio coefficient	--		--		--		--		2.174		0.940		1.128		0.535	
									(1.67)		(3.27)		(2.57)		(3.11)	
Goodness of Fit Measures																
Fraction of correct predictions for issuance decision	0.884		0.850		0.855		0.850		--		--		--		--	
R-Squared	0.36		0.22		0.24		0.36		0.91		0.80		0.52		0.62	
Number of observations	335		893		1276		1369		30		118		136		194	
Percent that issued subordinated debt	15.22		18.03		16.61		24.18		--		--		--		--	

Note: All specifications include a constant term which was significant at the 5% level. Year indicator variables, which were equal to one in the first year of each panel, and zero otherwise were also included though these coefficient estimates are not reported here. Observed spread regressions are heteroskedastic-consistent. t-statistics are in parentheses.

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