The Effect of Bank Organizational Risk-Management on the Pricing of Non-Deposit Debt: An Empirical Note

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In this paper, we analyze whether primary market bond investors price a bank holding company's (BHC) inside organizational risk management using a comprehensive sample of bond issuances by U.S. financial institutions. We find that primary bond yield spreads increase when the BHC has a weaker risk management function in place. Consistent with a moral hazard notion, the relationship between at-issue yield spreads and BHC risk organizational management is significantly weaker during periods of large-scale TARP bailouts. We also find that BHCs that maintained strong internal risk management controls in place before the 2007-2008 financial crisis years had lower debt financing costs during and post the financial crisis time period, compared to other banks. Overall, our results suggest that a strong and independent risk management function can curtail excessive risk exposures at banks and result in lower non-deposit bank financing costs.

1. Introduction

Incentives of managers can conflict with those of outside shareholders and creditors, particularly at highly leveraged and opaque institutions such as banks, where protections, such as deposit insurance, too-big-to-fail policies, and a lender of last resort reduce stakeholders' monitoring incentives (Bhattacharya, Boot, and Thakor, 1998). Agency problems arise both with respect to the outright transfer of resources (e.g., excessive managerial compensation) and/or implicit transfers related to risk management practices (e.g., inadequate risk management effort or transfers from creditors to stockholders through risk shifting). Some risk shifting benefits managers at the expense of all claimants on the bank, while other forms of risk shifting benefit managers and stockholders at the expense of creditors.[1] As a result, bankers design contracting and governance structures that sufficiently resolve agency problems so that they can attract shareholder and creditor funding.

One such governance mechanism involves the organizational risk management function, which measures a bank's exposure to credit, market, operational and other types of risk, communicates it to the board and top management and monitors it over time (Stulz, 2008). There is widespread evidence that high quality risk management is necessary to correctly identify risks and prevent excessive risk shifting by banks (Kashyap, Rajan and Stein, 2002; Stulz, 2008; Hoenig, 2008). For instance, a recent study by Ellul and Yerramilli (2013) finds that ceteris

[1] Risk shifting or asset substitution refers to conscious changes in the risk profile of investments designed to transfer value from some claimants on the firm to others. For example, the decision to invest less resources in risk management can result in private benefits to bankers at the expense of outside sources of funding (Holmstrom and Tirole, 1997). Also, an increase in the variance of returns typically transfers value from creditors to stockholders (Jensen and Meckling, 1976). These two kinds of risk shifting differ in the identities of winners and losers.

paribus, bank holding companies (BHCs) with a strong risk management function in place have lower tail risk compared to other banks with weaker organizational risk controls. In this study, we examine whether cross-sectional differences in non-deposit debt financing costs among BHCs in the United States can be explained by differences in the organizational structure of their risk management functions.[2]

Our main hypothesis is that BHCs with strong and independent organizational risk management should engage in less risk-taking and therefore issue bonds at lower costs, ceteris paribus. This is because without strong organizational risk control in place, high-powered pay-for-performance compensation packages of bank executives, combined with the high leverage in financial institutions incentivize managers and traders to exploit deficiencies in internal controls and take on excessive amounts of risk that cannot be fully constrained by regulatory supervision and external market discipline (Stulz, 2008; Acharya, Philippon et al., 2009). Such risk can enhance performance in the short run, but when it materializes can cause significant damage to the institution and increase its risk of default (Kashyap, Rajan and Stein, 2008). A strong bank risk management function is therefore important to correctly identify these risks and prevent such excessive risk taking, which in turn will lower the institution's cost of non-deposit debt.

Given that bondholders hold uninsured liabilities that do not share in the upside from excessive risk but may have to absorb losses when this risk materializes, it is rational to expect that they will demand higher at-issue yield spreads from institutions with a weaker risk management function in place. On the other hand, bondholders of systemically important financial

[2] We use the terms non-deposit debt financing, debt financing and bond financing interchangeably throughout the paper.

institutions may rationally anticipate a taxpayer-funded bailout of their institution in the event of a systemic crisis, and thus, may not price the institution's risk management function. Hence, the effect of BHC organizational risk management on the yield spread of newly issued bonds is an empirical issue that we address in the analysis.

To estimate whether organizational risk management affects a bank's cost of debt, we rely on a hand collected dataset that takes into account the organizational strength and independence of the risk management function of a given BHC. Constructed from variables that estimate the importance of the chief risk officer (CRO) and the bank's risk committee ability and experience, this measure is used as a proxy for the importance attached to the risk management function and the quality of risk oversight provided by the board of directors within a BHC.[3] Controlling for BHC and debt issuance characteristics, we find that BHCs with stronger organizational risk controls in the previous year have a lower at-issue bond yield spreads in the current year. These findings are consistent with the results in Ellul and Yerramilli (2013) that BHCs with stronger internal risk management policies in place undertake less excessive risk, and overall suggest that strong organizational risk controls are priced by bank creditors because they limit banks' incentives for excessive risk taking.

We then examine how the effect of risk management on bond spreads varies for institutions that were part of the Troubled Asset Relief Program (TARP) following the recent financial crisis. Consistent with the idea that implicit bailout guarantees may engender moral hazard problems

[3] The risk management index (RMI) we use in our estimations is a hand collected measure based on the 10K and proxy statements of the largest BHCs in the US in terms of book value of total assets at the end of 2007, representing more than 78% of total assets in the banking system that year. See data section for details. We thank Professors Ellul and Yerramilli for sharing their risk management index (RMI) data with us.

among bond market investors who rationally anticipate a taxpayer-funded bailout of their institution in the event of a systemic crisis (Strahan, 2013; Acharya et al., 2013), we find that the relationship between yield spreads and organizational risk management is significantly weaker for TARP institutions in the aftermath of the recent financial crisis.

We next examine whether BHCs that maintained strong internal risk management controls in place before and during the 2007-2008 financial crisis years had lower debt financing costs post the financial crisis time period, compared to other banks. We find that BHCs with strong organizational risk management practices before and during the financial crisis years had significantly lower debt financing costs following the crisis years compared to their counterparts with weak risk management controls. Conversely, banks with weaker organizational risk management in the pre-crisis years and during the crisis were penalized by creditors in the post crisis time period. This supports the view that a consistently strong risk management controls excessive risk-taking and is priced by the bank's creditors.

There are two possible interpretations for the robust negative association between at-issue bond yield spreads and institutional risk management. First is the casual interpretation that a strong bank risk management function lowers excessive risk taking by executives and traders, which in turn results in a lower risk of default and lower yield spreads. Alternatively, it could be the case that both BHC bond yield spreads and risk management are jointly determined by some unobserved time-varying risk preferences of the BHC. For example, the BHC may be responding to a recent bad experience by simultaneously lowering its exposure to risk (and therefore lowering its risk of default and debt financing costs) and strengthening its internal risk controls. To distinguish between these two channels we carry out additional tests, using an instrumental variable (IV) regression approach. The results suggest that our findings cannot be driven entirely by changes in a BHC's risk preferences that cause them to simultaneously lower (increase) risk exposures and strengthen (weaken) internal risk controls.

Our paper makes the following important contributions. First, it contributes to the literature that examines risk taking by banks (see, e.g., Keeley, 1990; Demsetz and Strahan, 1997; Demsetz, Sadenberg and Strahan, 1997; Hellman, Murdock and Stiglitz, 2000; Demirguc-Kunt and Detragiache, 2002; Laeven and Levine, 2009; and Ellul and Yerramilli, 2013) by examining how the strength and independence of a bank's risk management function affects its risk taking, and therefore its cost of debt financing. As far as we are aware, this is the only study that examines the impact of organizational risk management structure in banks on their cost of debt.

Second, our paper is related to the literature about the corporate governance of financial institutions, which examines the impact of board characteristics and ownership structure on bank performance and risk taking (e.g., see Beltratti and Stultz, 2009; Anginer, Demirguc-Kunt, Huizinga and Ma, 2013; Erkens, Hung and Matos, 2012; Holderness, Kroszner, and Sheehan, 1999; and Minton, Taillard and Williamson, 2010). While these studies find that stronger formal governance, coupled with high managerial ownership are associated with lower bank capital ratios, higher capitalization ratios and lower risk, our study documents that a stronger risk management function in a bank is also associated with a lower cost of non-deposit, uninsured debt.

Third, our paper is related to prior studies of bank market discipline that focus on whether uninsured bank liabilities such as certificates of deposit (CDs) and subordinated notes and debentures contain appropriate risk premia. The literature generally concludes that CD rates paid by large money-center banks include significant default risk premia (e.g., see Ellis and Flannery, 1992; Hannan and Hanweck, 1988; and Cargill, 1989). The main difference between our study and this literature is that we focus exclusively on the pricing of risk management of financial institutions in the bond market. Similar to Avery, Belton, and Goldberg (1988) and Gorton and Santomero (1990), we fail to find any evidence that subordinated bondholders of depository institutions care more about risk management than senior bondholders. Also, similar to Flannery and Sorescu (1996), we find that the pricing of risk changes with expectations of government bailouts.

Finally, our paper is closely related to and complements the results in Acharya et al. (2013) who find that secondary bond yield spreads of large financial institutions are lower compared with other financial institutions even after controlling for their risk exposures. They attribute this phenomenon to investor expectations of implicit state guarantees for large institutions. Our paper differs from theirs in the following respects: First, we focus on primary bond yield spreads that directly reflect the institutions' cost of debt capital. Second, our analysis is focused on the pricing of organizational risk management in banks that are of particular concern to bondholders. Our study also complements the findings in Chava, Garduri and Yerramilli (2014) who find that the exposure of banks to higher tail risk, measured by expected loss conditional on returns being less than some α-quintile, are associated with a higher cost of debt. Our paper defers from theirs because we focus on the quality of the organizational risk management function of financial institutions that are put in place to identify the optimal amount of risk a bank should undertake.

The remainder of the paper is organized as follows. We describe our data sources and construction of variables in Section 2, and provide descriptive statistics and preliminary results in Section 3. We present our main empirical results in Section 4. Finally, section 5 concludes the paper.

2. Data, Sample Construction and Key Variables

Our data come from several sources. For our organizational bank risk management measure, we use the risk management index (RMI) constructed by Professors Ellul and Yerramilli, who hand collect data on the organizational structure of the risk management function at BHCs using annual 10-K and proxy statements. Given the effort involved in manually collecting and validating the information for each BHC, their dataset is restricted to the 100 largest BHCs, in terms of the book value of their total assets at the end of 2007. Although there were over 5,000 BHCs at the end of 2007, the top 100 BHCs account for close to 92% of the total assets of the banking system.

To construct RMI, Ellul and Yerramilli hand collect different measures that identify the importance of the Chief Risk Officer (CRO, that is, the official exclusively charged with managing enterprise risk across all business segments of the BHC) and the quality of risk oversight provided by the BHC's board of directors, and use the first principal component of these measures on a year-by-year basis. Specifically, they use the following six risk management variables: *CRO Present*, a dummy variable that identifies whether a CRO (or an equivalent function) responsible for enterprise-wide risk management is present within the BHC; *CRO Executive*, a dummy variable that identifies whether the CRO is an executive officer of the BHC; *CRO Top5,* a dummy variable that identifies whether the CRO is among the five highest paid executives at the BHC; *CRO Centrality*, defined as the ratio of the CRO's total compensation, excluding stock and option awards, to the CEO's total compensation; *Risk Committee Experience,* a dummy variable that identifies whether at least one of the independent directors serving on the board's risk committee has banking and finance experience; and *Active Risk Committee,* a dummy variable that identifies whether the BHC's board risk committee met more frequently during the year compared to the average board risk committee across all BHCs.

We next obtain primary bond market data from the Securities Data Corporation (SDC) New Issues database over the 1998-2010 time period. For the purpose of calculating our main dependent variable of interest, at-issue bond yield spreads, we use the risk-free term structure of interest rates taken from Bloomberg, including the monthly treasury benchmark yields with 2, 3, 5, 7, 10, and 30 year coupon bonds. To control for the effect of bond covenants on the relationship between BHC risk management and at-issue bond yield spreads, we gather information from the Fixed Income Securities database (FISD) on covenant provisions related to leverage restrictions, net worth restrictions and the existence of a poison put, as these have been shown to significantly affect bondholders' reaction to risk of default (Asquith and Wizman, 1990; Cremers, Nair and Wei, 2007).

For bond issues to be included in our analysis, data on the amount, yield, coupon rate, duration, time to maturity, leverage, assets, and credit rating of the firm's fixed coupon rate straight public debt issues must be available on the SDC and Compustat databases. We restrict our sample to U.S. domestic bonds and exclude Yankee bonds, bonds issued via private placements, and issues that are asset-backed or have credit-enhancement features. We also exclude preferred stocks, mortgage-backed securities, trust-preferred capital, and convertible bonds. We include only ratings issued by the top three NRSROs – Standard and Poor (S&P), Moody's, and Fitch.

To obtain Rating, we first convert the credit ratings provided by S&P (Moody's) into an ordinal scale starting with 1 as AAA (Aaa), 2 as AA+ (Aa1), 3 as AA (Aa2), and so on until 22, which denotes the default category. As Fitch provides three ratings for default, we follow the existing literature and chose 23 instead of 22 for the default category, which is the average of the three default ratings; i.e., DD. Because each bond issue may be rated by multiple agencies, we compute rating as the issue size based weighted average of the ordinal rating assigned by each rating agency. Note that by construction, a lower value for Rating denotes a better credit quality at issuance. This leaves us with a sample of 170 bond issues by 37 BHCs.

3. Descriptive Statistics and Preliminary Results

We present summary statistics for the risk management variable, bond issuance, financial, and governance characteristics for the BHCs in our panel data set in Table 1. The panel data comprise one observation for each BHC-year combination, during the 1998 to 2010 time period, and include the 37 publicly listed, bond issuing BHCs in our sample. Note that when a BHC issues more than one bond in a given year, we calculate the weighted average yield for the bonds issued during that year by the firm, where the weighted average yield is calculated by multiplying each yield with its equivalent weight, computed as the amount outstanding for each debt security divided by the total amount outstanding for all publically issued bonds in that year.

[Insert Table 1 about Here]

Our primary measure for the quality and strength of a bank's organizational risk management is RMI. This index is computed using principal component analysis and is based on measures of the importance of a bank's CRO, as well as the quality and expertise of its risk committee. Higher scores indicate stronger organizational control over a bank's risk taking. The opposite is true for low scores. As can be seen, the mean RMI in our sample is 0.819. The summary statistics on RMI indicate that our index is not highly skewed, and does not suffer from the presence of outliers.

The size distribution of BHCs, in terms of the book value of their assets, is highly skewed with total assets varying from $42 million at the lower end to over $1 trillion at the higher end, after adjusting for natural log transformation. Given the skewness of the size distribution, we use the logarithm of the book value of assets, denoted as *Size*, as a proxy for BHC size in all our empirical specifications. Moreover, in our empirical analysis, we check for a possible nonlinear relation between size and risk characteristics. We also control for bank balance sheet composition. The average value of tier-1 capital, scaled by assets (*TIER1*) is 7.6%; Total interest income over net operating income (*NONINT*) for the BHCs in our sample is 46.3%, and the value of loans (*LOAN*) and deposits (*DEPOSIT*) represents 57.8% and 58.8% of asset size, on average, respectively. The sample BHCs are also profitable with a mean ROA of 1.2% and median of 1.3%. On average, the BHCs in our sample are followed by 18 analysts (*#ANALYSTS*), and 76% of their board members are independent (*INDEP*).

In terms of bond related variables, the at-issue yield spread (*SPREAD*) in our sample has a mean of 146.2, median of 104.8, and standard deviation of 121.7 basis points. The average principle scaled by total assets (*PRCPL*) has a mean value of 0.6%, and a standard deviation of 1%. The mean time to maturity (*MATURITY*) of the bonds in our sample is 9.1 years, with a standard deviation of 6.8 years. The mean of the bond rating variable (*RATING*), is roughly equal to Moody's ratings of A3. On average, about 59% of the bond issues in our sample have covenants.

In Panel A of Table 2, we seek to better understand the differences in characteristics between BHCs with strong risk controls (high RMI) and BHCs with weaker risk controls (low RMI). To do so, we define *High RMI* (*Low RMI*) to identify, in each year, BHCs whose RMI is greater (lower) than the median value of RMI across all BHCs during the year. We then run a univariate comparison of the mean values of various BHC characteristics between the two subsamples.

[Insert Table 2 about Here]

As can be seen, BHCs with high RMI are larger in size. This is not surprising because larger BHCs are more likely to be involved in riskier nonbanking activities, and hence are more likely to benefit from a strong risk management function. They are also more likely to be able to afford the costs of implementing a strong risk management function.

BHCs with high RMI have lower Tier-1 capital ratio, which is consistent with the notion that BHCs exposed to greater risk should adopt stronger risk management functions. The difference in Tier-1 capital between high and low RMI banks is, however, insignificant. Along these lines, we also find that BHCs with high RMI are exposed to greater liquidity and credit risk, as they have more deposits and loans as a fraction of their assets than their counterparts with low RMI.

In terms of governance characteristics, we find that BHCs with high RMI have a higher fraction of independent board members and analyst following. Consistent with the idea that high RMI banks tend to be exposed to greater risk, we find that these banks issue bonds with higher ratings, shorter maturity and smaller proceeds size. These banks, however, tend to use less covenants than banks with low RMI scores.

In Panel B of Table 2, we examine the difference in average at-issue spreads between BHCs with high and low RMI measures. The univariate comparison is consistent with the notion that high quality, strong organizational risk management can mitigate a bank's excessive risk taking incentives, and therefore lower its risk of default and cost of debt. As can be seen, the at-issue yield spread for low RMI banks is 170 basis points, compared to 123.9 basis points for high RMI banks. The difference is statistically significant at the 5% level. We note that when we segment bond issues to before and after 2008, while at-issue yield spreads increase following the financial crisis for both high and low RMI banks, the spread differential between high and low RMI BHCs widens to more than 130 basis points following the financial crisis time period. This is consistent with the idea that BHCs that did not have a strong organizational risk management function in place were particularly penalized by bondholders following the onset of the financial crisis.

We must caution that the differences listed in Panel B are simple univariate differences that do not control for differences in other BHC characteristics, most notably BHC size. We conduct a formal multivariate analysis below in Section 3, where we control for these other important differences.

4. Empirical Results

4.1. Bond At-Issue Yield Spreads and BHC Risk Management

We begin our empirical analysis by examining whether investors in the primary bond market price the risk management function of the BHCs issuing the bonds. To test this, we estimate the following OLS regression model:

$$Spread_{ift} = \alpha + \beta * RMI_{f,t-1} + \gamma * X_{f,t-1} + \delta * X_i + Year\ FE + BHC\ FE$$

In the above equation, we use subscript '*i*' to denote the bond, subscript '*f*' to denote the issuer BHC, and subscript 't' to denote the year of issuance. Each observation in the regression sample corresponds to a primary bond issue. [4] The main dependent variable of interest is the bond's yield spread at issuance (*Spread)*. The main independent variable of interest is *RMI*, which proxies for the strength and quality of the BHC's organizational risk management in the prior year. We control for important firm characteristics (*Xf*), issue characteristics (*Xi*), and macroeconomic variables that may affect at-issue yield spreads. All the variables are defined in the Appendix. The

[4] Following Klock, Mansi and Maxwell (2005), among others, when a BHC issues more than one bond in a given year, at-issue yield spreads, as well as all bond related variables are combined into a single weighted average measure, based on the proceeds size of the issue and the total amount outstanding of bond debt for the BHC during that year.

BHC characteristics that we control for are *Size*, Profitability (*ROA*), Tier-1 capital ratio (*TIER1)*, BHC Z-score (*Z_SCORE*), interest income over net operating income (*NONINT)*, deposits scaled by assets *(DEPOSIT),* loans over assets *(LOAN*), the fraction of independent board members (*%INDEP)* and the number of analysts following the firm (*#ANALYSTS*). The issue characteristics that we control for are the bond's Rating (*Rating)*, issue size scaled by assets (*PROCEEDS*), bond maturity (*MATURITY*), and an indicator variable to identify the existence of covenants (*COV*). We also include year and BHC fixed effects in all specifications.

[Insert Table 3 about Here]

The main independent variable of interest is *RMI* in Table 3. The negative and significant coefficient on *RMI* in column (1) indicates that yield spreads at issuance are lower for bonds issued by BHCs with strong risk management in place. A one standard deviation increase in *RMI* decreases the primary bond issuance yield by 19.37 basis points. In columns (2) and (3), we also control the fraction of independent board members and the number of analysts following the BHC, respectively.

The coefficient on the *RMI* variable remains negative and significant, however, at the 1% level. The coefficients on the control variables in columns (1)-(3) are broadly as expected. The negative (positive) coefficients on *RATING* (*MATURITY*) indicate that yield spreads are higher for lower rated bonds and longer maturity bonds, whereas the positive coefficient on issue proceeds indicates that yield spreads are higher for larger issues. Examining firm characteristics, we find that yield spreads are higher for institutions with higher Tier1 capital and loan size. This could indicate that well capitalized, large banks are more prone to undertaking greater risk, which results in higher at-issue spreads. We also note that controlling for issue size, the size of the institution has no effect on yield spreads.

As we show in Table 1, the size distribution of BHCs is highly skewed. Therefore, it is also important to check for a possible nonlinear relationship between *RMI* and size. One way to do this is to include size-decile fixed effects to control for unobserved heterogeneity across BHCs in different size categories. Column (4) of Table 3 presents the results controlling for size deciles, however, the results remain qualitatively unchanged.

To summarize, the results in Table 3 suggest that primary bond market investors care about the institution's organizational risk management and associate a lower spread to strong, high quality institutional risk controls.

4.2. Risk Management and Bond Spreads During and Following the Financial Crisis

We continue our analyses by examining whether BHCs that had stronger internal risk controls in place before the onset of the financial crisis were more judicious in their risk exposures and therefore were able to issue bonds at lower costs during and following the crisis years. To investigate this conjecture, we define a BHC's Pre-Crisis RMI (*PRE_RMI*) as the average of its RMI 2005 and RMI 2006. We are interested in this variable because institutions with strong risk controls would have identified risks and started taking corrective actions in as early as 2006, when it was easier to offload holdings of mortgage-backed securities and CDOs, and was relatively cheaper to hedge risks.

To test whether BHCs that had stronger risk management practices in place during the pre-crisis years fared better during and following the crisis, for each BHC-bond issue, we define *CRISIS* as 1 if a bond was issued during or after 2007, and 0 otherwise. Column (5) of Table 3 presents the results, where we interact *PRE_RMI* with *CRISIS*. The coefficient on the interaction term suggests that compared to similar banks with weaker pre-crisis RMI practices, BHCs that were more judicial during the pre-crisis years, were able to issue their bonds in significantly lower costs. More specifically, for the average BHC with a RMI standard deviation of 0.259 during the sample years, a one standard deviation increase in RMI during 2005-2006 is associated with an at-issue yield spread decrease of 27.51 basis points, ceteris paribus. This supports the view that consistently strong risk management controls excessive risk-taking and is priced by the bank's creditors, especially during financial crisis years.

4.3. Risk Management and Bond Spreads of BHCs that Participate in the Troubled Asset Relief Program (TARP)

In this section, we focus on cross-sectional variation in bailout expectations across financial institutions. One such source of cross-sectional variation is the bailout Troubled Asset Relied Program (TARP) that was announced in 2008, with the intention to buy senior preferred stock and warrants from the nine largest American banks. If bondholders expect these banks to receive government bailouts, then we expect the relationship between at-issue bond yield spreads and RMI to be weaker for BHCs that were expected to be part of the bailout program.

To test whether the pricing of RMI varies with the institutions' TARP bailout expectations, we estimate a regression where we interact *TARP*, a dummy variable that denotes whether the BHC was one of the nine banks who were identified as recipients of bailout funds in 2008, with *RMI*. The results of our analysis are presented in Table 3 Column (6). The negative and significant coefficients on *TARP*RMI* in column (6) indicates that the relationship between at-issue yield spreads and organizational risk management is indeed weaker for institutions that were expected to receive governmental TARP support. This supports a moral-hazard hypothesis by highlighting that primary bond market investors are less likely to price organizational risk management of institutions with governmental bailout expectations.

4.4. Instrumental Variable Regressions

Our results so far lend themselves to two possible interpretations. First, a strong risk management function lowers the probability of bank default by restraining risk-taking behavior within the BHC, and is therefore associated with lower at-issue yield spreads. Second, given that the choice of risk management function may itself be endogenous, it could be the case that both the risk and the risk management function are jointly determined by some unobserved time-varying omitted variable (note that we control for time-invariant omitted variables through inclusion of BHC fixed effects), for example, a change in the risk preferences of the BHC that causes it to simultaneously lower (increase) risk and at-issue yield spreads and strengthen (weaken) internal risk controls. We believe that both these channels are important in practice, and that it is difficult to empirically distinguish between them. Nonetheless, in this section, we carry out additional tests to verify that our results are not being driven entirely by time-varying risk preferences of BHCs.

In this section we replicate our panel regressions using an instrumental variable approach. We specifically replicate the approach in Ellul and Yerramilli (2013) who examined how BHCs changed their RMI in response to their experiences in the 1998 crisis. As noted by Ellul and Yerramilli (2013), there was a significant across-the-board increase in RMI during the 1998 to 2000 period, which may be due in part to the experience of BHCs during the 1998 Russian crisis, and in part to the passage of the Gramm–Leach–Bliley Act in 1999.

A key property of an instrument is that it should not have any direct effect on the dependent variable in the regression (i.e., at-issue yield spreads in the years after the Russian crisis, 2001-2010). It could be argued that a BHC's own increase in RMI over the 1998 to 2000 period does not satisfy this key property required of an instrument, because the underlying business model or risk culture of the BHC, which may be persistent (see Fahlenbrach, Prilmeier, and Stulz, 2012), can affect both the BHC's response to the Russian crisis and its performance and risk in subsequent years. Therefore, for each BHC, we instead focus on the average RMI 1998 – 2000 (that is RMI in the year 2000 minus RMI in 1998) for all *other* BHCs (i.e., excluding the BHC itself) in the size decile to which the BHC belonged in 1998. We refer to this variable as Comparable BHCs' RMI in 1998 – 2000, and use it as an instrument for the BHC's RMI in subsequent years, 2001 and beyond.

The rational for using this instrument is as follows. Comparable BHCs' RMI 1998 – 2000 does not have any direct impact on the BHC's at-issue yield spreads during the subsequent years (2001-2010) or its performance during the financial crisis years, and any impact is only through its effect on RMI in subsequent years. First, Comparable BHCs' RMI 1998 – 2000 is not specific to a particular BHC; it is only an average measure over all other BHCs in the size decile to which the BHC belonged in 1998. Second, as Fahlenbrach, Prilmeier, and Stulz (2012) note, the proximate causes of the 1998 crisis were very different from those of the financial crisis in 2007 to 2008; the former was triggered by events in Russia whereas the latter was triggered by problems in the housing sector in the United States. Therefore, it is unlikely that Comparable BHCs' RMI 1998 – 2000 is picking up any commonalities in investment decisions during 1998 and the years leading up to the financial crisis. Accordingly, in the panel regressions, we limit the sample to the 2001 to 2010 period, so that there is a gap of at least three years between the 1998 crisis and our sample period.

In Panel 4, we present the results of the crisis-period regressions using the IV regression approach implemented using the two-stage least squares (2SLS) estimator. We present the second stage results for brevity. The empirical specification is very similar to that in Table 3, except that we use the instrumented value of Pre-Crisis RMI estimated from a first-stage regression with Comparable BHCs' RMI 1998 – 2000 as an exogenous instrument.

[Insert Table 4 about Here]

As can be seen from columns (1) through (5) in Table 4, the results of the IV regression are qualitatively similar to the corresponding results in Table 3. Overall, the results in 4 support the argument that BHCs with strong and independent risk management functions in place were more judicious in their risk exposures, and were able to issue bonds at lower costs. In addition, these results indicate that the relationship between spreads and RMI cannot be fully explained by BHC time-varying risk preferences that cause BHCs to simultaneously change their risk management functions and risk exposure.

5. Conclusion

In this paper, we examine the organizational structure of the risk management function at BHCs in the United States, and investigate whether differences in at-issue yield spreads across BHCs can be explained by differences in the strength of their risk management functions. We use the RMI measure, manually constructed by Ellul and Yerrammilli (2013) to measure the strength and independence of the risk management functions at BHCs.

We find that BHCs with stronger risk management functions (i.e., higher RMI) in place in the previous year have a lower at-issue bond yield spreads in the current year. These findings are consistent with the results in Ellul and Yerramilli (2013) that BHCs with stronger internal risk management policies in place undertake less excessive risk, and overall suggest that strong organizational risk controls are priced by bank creditors because they limit banks' incentives for excessive risk taking.

We also find that consistent with the idea that implicit bailout guarantees may engender moral hazard problems among bond market investors who rationally anticipate a taxpayer-funded bailout of their institution in the event of a systemic crisis, the relationship between yield spreads and organizational risk management is significantly weaker for TARP institutions in the aftermath of the recent financial crisis.

Finally, we find that BHCs that maintained strong internal risk management controls in place before the 2007-2008 financial crisis years had lower debt financing costs during and post the financial crisis time period, compared to other banks. Conversely, banks with weaker organizational risk management in the pre-crisis years were penalized by creditors during and post the crisis. This supports the view that a strong and independent risk management function can curtail tail risk exposures at banks and lower non-deposit debt financing costs at BHCs, particularly during crisis years.

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Appendix

Data Definitions

SPREAD	Weighted average of bond spread for the year (in percentage points)
RMI	Risk management index at the beginning of the year
SIZE	Natural log of total assets at the beginning of the year
EQUITY_RATIO	The ratio of stockholders' equity to total assets at the beginning of the year
ROA	Annual income before extraordinary items over beginning total assets
RATING	Weighted average of S&P credit rating
Z_SCORE	Natural log of the sum of ROA and capital asset ratio over the standard deviation of ROA in the most recent 5 years
MATURITY	Weighted average of bond maturity for the year
PRCPL	Annual average principle of bonds over beginning total assets
NONINT	Total noninterest income over net operating income for the year
DEPOSIT	Total deposits over total assets at the beginning of the year
LOAN	Total loans over total assets at the beginning of the year
COV	1 if bonds issue with debt covenant, and 0 otherwise
%INDEP	Percentage of independent directors on the board of directors for the year
#ANALYSTS	Number of analysts issuing earnings forecasts at the beginning of the year
PRE_RMI	Average RMI of a given BHC in the years 2005, 2006
CRISIS	1 if the bond is issued in years 2007 and after, and 0 otherwise
TARP	1 if the bank received TARP money in 2008, and 0 otherwise

Table 1
Summary Statistics (1998-2010, and 37 BHCs)

Variable	*N*	*Mean*	*Standard Deviation*	*Lower Quartile*	*Median*	*Upper Quartile*
SPREAD	170	1.462	1.217	0.740	1.048	1.700
RMI	170	0.819	0.259	0.594	0.846	1.010
SIZE	170	11.757	1.608	10.645	11.658	13.086
EQUITY_RATIO	170	0.093	0.073	0.075	0.084	0.094
ROA	170	0.012	0.015	0.008	0.013	0.016
RATING	170	16.955	2.818	16	17.5	18.745
Z_SCORE	170	3.762	0.967	3.206	3.828	4.370
MATURITY	170	9.136	6.838	5	8.292	10
PRCPL	170	0.006	0.010	0.001	0.003	0.007
NONINT	170	0.463	0.156	0.368	0.438	0.534
DEPOSIT	170	0.588	0.172	0.556	0.633	0.686
LOAN	170	0.578	0.197	0.453	0.667	0.715
COV	170	0.588	0.494	0	1	1
%INDEP	150	0.760	0.133	0.692	0.800	0.857
#ANALYSTS	155	18.226	6.845	13	20	23
CRISIS	170	0247	0.433	0	0	0
PRE_HIGH	170	0.612	0.489	0	1	1
PRE_LOW	170	0.382	0.487	0	0	1
HIGH_HIGH	170	0.471	0.501	0	0	1
LOW_LOW	170	0.282	0.451	0	0	1
TARP	170	0.224	0.418	0	0	0

Table 2

Comparison between Low-RMI and High-RMI banks (N=170, 1998-2010, and 37 BHCs)

Panel A: Comparison of Control Variable

Variables	Low RMI	High RMI	Difference	t-Statistics
SIZE	11.523	11.975	-0.452	-1.83
EQUITY_RATIO	0.099	0.086	0.013	1.15
ROA	0.012	0.012	0.000	0.05
RATING	16.275	17.588	-1.313	-3.11
Z_SCORE	3.710	3.810	-0.100	-0.67
MATURITY	10.177	8.166	2.011	1.9
PRCPL	0.008	0.004	0.003	2.19
NONINT	0.467	0.460	0.008	0.32
DEPOSIT	0.539	0.634	-0.095	-3.65
LOAN	0.542	0.610	-0.068	-2.24
COV	0.720	0.466	0.254	3.47
%INDEP	0.735	0.782	-0.048	-2.19
#ANALYSTS	15.941	20.012	-4.070	-3.87
TARP	0.195	0.250	-0.055	-0.86

Panel B: Comparison of Variable of Interest

		N	Low RMI	High RMI	Difference	t-Statistics
SPREAD	Full sample	170	1.702	1.239	0.463	2.48
	Before 2007	115	1.090	0.850	0.240	2.73
	2007 and after	55	3.020	2.030	0.990	2.34

Table 3 The association between SPREAD and RMI (N=170, 1998-2010, and 37 BHCs, bank-level cluster adjusted t-stats in parentheses, *** p<0.01, ** p<0.05, * p<0.1.)

	(1)	(2)	(3)	(4)	(5)	(6)
RMI	-0.748***	-0.872***	-0.742**	-0.735***	-0.439*	-0.242
	(-2.88)	(-2.76)	(-2.44)	(-2.83)	(-1.79)	(-0.94)
SIZE	0.009	0.003	0.015	0.242	-0.011	0.003
	(0.11)	(0.03)	(0.16)	(0.72)	(-0.14)	(0.04)
EQUITY_RATIO	3.416	3.428	3.924	2.623	2.612	3.350
	(1.04)	(1.09)	(1.20)	(0.74)	(0.87)	(1.26)
ROA	-49.136***	-40.203***	-51.481***	-47.472***	-45.430***	-38.861***
	(-3.19)	(-2.89)	(-3.13)	(-3.11)	(-3.17)	(-3.12)
RATING	-0.075	-0.103	-0.076	-0.070	-0.067	-0.093*
	(-1.54)	(-1.50)	(-1.48)	(-1.55)	(-1.38)	(-1.89)
Z_SCORE	-0.176**	-0.084	-0.127*	-0.169**	-0.182**	-0.033
	(-2.17)	(-1.10)	(-1.79)	(-2.24)	(-2.34)	(-0.50)
MATURITY	0.017*	0.010	0.015	0.017	0.015*	0.020*
	(1.87)	(1.08)	(1.67)	(1.65)	(1.88)	(1.90)
PRCPL	29.051*	14.185	28.620*	31.402*	27.138*	21.673
	(1.86)	(0.66)	(1.86)	(1.71)	(1.86)	(1.38)
NONINT	0.584	0.176	0.711	0.560	0.665	0.501
	(0.94)	(0.22)	(0.98)	(0.85)	(1.08)	(0.75)
DEPOSIT	0.240	0.349	0.234	0.189	0.040	-0.488
	(0.49)	(0.58)	(0.46)	(0.34)	(0.08)	(-0.96)
LOAN	0.804	0.394	0.907	0.690	0.969*	0.928
	(1.45)	(0.57)	(1.41)	(1.27)	(1.77)	(1.43)
COV	0.099	0.137	0.095	0.082	0.105	0.250*
	(0.66)	(0.86)	(0.66)	(0.51)	(0.73)	(1.74)
CRISIS	1.059***	1.344***	1.068***	1.050***	2.032***	
	(5.12)	(6.25)	(4.86)	(4.71)	(3.74)	
%INDEP		-0.321				
		(-0.61)				
#ANALYSTS			-0.000			
			(-0.04)			
CRISIS*PRE_RMI					-1.062**	
					(-2.05)	
TARP						3.445***
						(6.69)
TARP*RMI						-2.231***
						(-4.59)
CONSTANT	2.575**	3.485**	2.229*	0.625	2.475**	2.251**
	(2.31)	(2.19)	(1.72)	(0.21)	(2.25)	(2.46)
Observations	170	150	155	170	170	170
Size deciles	No	No	No	Yes	No	No
Adjusted R-squared	0.606	0.641	0.591	0.595	0.613	0.645

Table 4
2SLS Results (N=139, 2001-2010)

	(1)	(2)	(3)	(4)	(5)
Predict_RMI	-2.349**	-2.753***	-2.460**	-2.256**	-2.025**
	(-2.52)	(-2.73)	(-2.30)	(-2.38)	(-2.29)
SIZE	0.108	0.062	0.116	-0.177	0.101
	(0.84)	(0.41)	(0.79)	(-0.43)	(0.83)
EQUITY_RATIO	5.062**	5.955**	4.892*	4.168	5.672**
	(1.99)	(2.00)	(1.76)	(1.45)	(2.34)
ROA	-35.688***	-31.083**	-36.963***	-35.766***	-36.811***
	(-3.10)	(-2.39)	(-3.02)	(-3.07)	(-3.35)
RATING	-0.059	-0.072	-0.055	-0.055	-0.077**
	(-1.62)	(-1.61)	(-1.39)	(-1.41)	(-2.20)
Z_SCORE	-0.080	-0.058	-0.024	-0.083	-0.063
	(-0.89)	(-0.55)	(-0.25)	(-0.90)	(-0.73)
MATURITY	0.019	0.017	0.017	0.024	0.026*
	(1.22)	(0.85)	(1.01)	(1.45)	(1.72)
PRCPL	2.335	-14.086	2.222	5.561	8.372
	(0.12)	(-0.59)	(0.11)	(0.26)	(0.46)
NONINT	0.762	0.294	0.592	0.902	0.646
	(1.02)	(0.32)	(0.68)	(1.12)	(0.90)
DEPOSIT	1.881	2.254	1.346	1.480	1.525
	(1.28)	(1.35)	(0.95)	(0.97)	(1.08)
LOAN	1.122*	0.569	1.043	1.209	1.039
	(1.66)	(0.70)	(1.33)	(1.60)	(1.60)
COV	0.224	0.211	0.258	0.190	0.238
	(1.36)	(1.14)	(1.51)	(1.08)	(1.50)
CRISIS	1.450***	1.460***	1.419***	1.534***	
	(6.25)	(5.50)	(5.48)	(5.78)	
%INDEP		-0.003			
		(-0.00)			

#ANALYSTS			0.001		
			(0.04)		
TARP					1.476***
					(6.57)
CONSTANT	0.626	1.981	0.861	3.361	0.833
	(0.32)	(0.76)	(0.40)	(0.87)	(0.44)
Observations	139	121	129	139	139
Size deciles	No	No	No	Yes	No
Adjusted R-squared	0.554	0.500	0.525	0.544	0.587

*** p<0.01, ** p<0.05, * p<0.1.

Following Ellul and Yerramilli (2013), we use the average change in RMI from 1998 to 2000 for other BHCs in the same size decile as an instrument for RMI for a given BHC in subsequent years, 2001-2010.