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Does the market discipline banks? New evidence from regulatory capital mix

Adam B. Ashcraft

Banking Studies, Federal Reserve Bank of New York, USA

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Abstract

While bank capital requirements permit a bank to freely substitute between equity and subordinated debt, lenders and investors view debt and equity as imperfect substitutes. It follows that, after controlling for the level of regulatory capital, the mix of debt in capital isolates the role that the market plays in disciplining banks. I document that the mix of debt in capital affects bank behavior, but only when investors can impose real constraints. In particular, the mix of debt reduces the probability of failure and future distress for BHC-affiliated institutions (where the investor has control rights through an equity position) and for stand-alone banks before the Basel Accord (when debt issues included restrictive covenants). However, substituting equity for subordinated debt at the bank holding company level or in stand-alone banks since the Basel Accord (where the investor has few protections) only increases the probability of distress and failure.

1. Introduction

Economists and bank regulators have recently shown great interest in involving the market more in the supervision of banks, particularly through the use of mandatory subordinated debt requirements. A proposal by a group of economists at the American Enterprise Institute (1999) recommended to the Basel Committee on Bank Supervision that the current risk-based capital framework be scrapped and replaced by tougher leverage requirements, part of which would be met through the issue of subordinated debt. Recently, Evanoff and Wall (2000) have proposed adding a mandatory subordinated debt requirement to the current risk-based capital regime, where institutions regularly roll over short-term debt. The potential for market discipline created

E-mail address: adam.ashcraft@ny.frb.org.

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by subordinated debt has also been considered extensively in a Staff Study by the Board of Governors of the Federal Reserve System (1999). Moreover, the third pillar of the Revised Basel Accord is predicated on market discipline through increased transparency and disclosure.

How might the market help regulate banks? There are two potential mechanisms. First, the market could provide information about default risk that helps supervisors allocate resources to the right places, or prevents supervisors from forbearing against problem banks. Second, the market could discipline banks directly by including restrictive covenants on debt issues or by recognizing franchise value in a bank's stock price, either of which would mitigate moral hazard during financial distress.

The existing empirical literature has largely focused on evaluating the efficacy of this first mechanism, i.e. the ability of bond holders to price changes in bank risk. While early research found little relationship between the measured subordinated debt spreads over US Treasuries and the measured risk from the bank balance sheet, studies using more recent data have more successfully found evidence that subordinated debt holders are effective monitors of bank behavior.[1] The conventional interpretation of the newfound relationship between spreads and risk is that subordinated debt holders felt safe under implicit guarantees by the FDIC to assume any losses, which were ended by Congress through FDICIA in 1991.[2]

However, the crucial question is not whether or not the price of debt is sensitive to risk, but whether or not this risk-pricing (or enforcement of covenants) would actually deter banks from taking risks that they would otherwise take. The only notable study on this issue is conducted by Bliss and Flannery (1999), who make a clear distinction between monitoring and influencing by debt holders, but fail to find any evidence that the market influences bank behavior.[3] This paper attempts to fill this gap in the literature by measuring the direct effect of subordinated debt on bank behavior.

A starting point for such an investigation must be Levonian (2001), who argues that a substitution away from equity towards subordinated debt in a bank's capital structure only increases

[1] Avery et al. (1988) found no evidence in a sample of the 100 largest Bank Holding Companies over 1983–1984 that debt spreads were sensitive to either ratings by Moody's or Standard and Poor's or an FDIC index of risk. Gorton and Santomero (1990) argued that the spread-risk relationship should actually be non-linear, as the payoffs to subordinated debt effectively look like those to equity when leverage is high. This observation did little, however, to help uncover a relationship between debt prices and risk, casting serious doubts on the ability of subordinated debt to impose any market discipline on banks.

Flannery and Sorescu (1996) investigated the issue over a longer panel using more recent data (1983–1991) on 422 bonds issued largely by Bank Holding Companies. The authors found that spreads are sensitive to measures of leverage, accruing loans past due, and real estate holdings of the holding company, but that this relationship is strongest with more recent data. These findings were largely confirmed by DeYoung et al. (1998). Jagtiani et al. (1999) find evidence that there is little difference between the pricing of debt issued by banks or bank holding companies. Morgan and Stiroh (1999) also present evidence that the spread–risk relationship on bank bonds is weaker for larger and less transparent banks.

[2] This story is difficult to reconcile, however, with widespread evidence that depositors have imposed market discipline on banks. Hannan and Hanweck (1988) found that interest rates on Jumbo Certificates of Deposit issued by 300 large banks in 1985:I were sensitive to balance sheet measures of risk. Park and Peristiani (1998) found evidence, in a sample of Savings and Loans over 1987–1991, that banks predicted to fail on the basis of balance sheet characteristics paid higher interest rates to uninsured depositors and had slower growth rates of uninsured deposits. Finally, Cook and Spellman (1994) concluded that GAAP insolvent Savings and Loans paid risk premia on their insured deposits in 1987–1988.

[3] The authors study a sample of 107 Bank Holding Companies over 1986–1998 that issued Y-9 Call Reports to the Federal Reserve, had stock prices reported in the CRSP Stock Returns and Master Files, and bond prices in the Warga/Lehman Brothers Corporate Bond Database. The authors found no evidence that bank behavior responds to excess security returns, and concluded that neither bond holders nor stockholders prominently influence managerial action.

leverage. This, in turn, worsens the underlying incentives for excessive risk-taking created by the mis-pricing of deposit insurance. If the presence of subordinated debt in a bank's capital structure is going to create market discipline, this effect is going to have to be powerful enough to offset the effect that higher leverage has on bank behavior. Whether or not the bank's reputation and these debt covenants are enough to eliminate the greater incentive for moral hazard created by increased leverage is the question tested by this paper.

In order to measure the ability of bond investors to influence bank behavior, it is necessary to rule out the possibility that any corrective behavior is being driven by pressure from regulators. A natural way to circumvent this identification problem is to recognize that regulators and bond holders care about different measures of capital. On the one hand, subordinated debt investors view equity capital as the amount of losses that the bank can absorb before eating away their claims. On the other hand, to a first approximation, regulatory capital is the sum of equity capital and subordinated debt, and represents the amount of losses that the bank can absorb before eating away at the claims of depositors. In order to measure market discipline, a simple exercise would be to compare banks with the same regulatory capital ratios (thus facing similar pressure from regulators), but different amounts of subordinated debt on their balance sheets (thus facing different pressure from investors). Given a measure of financial distress, a reasonable test of market discipline would be to compare, across the mix of debt in regulatory capital, the ability of financially distressed banks to recover.

An important challenge in implementing this strategy is that the presence of subordinated debt on a bank balance sheet is not exogenous. The most obvious concern is that within-bank variation in the capital mix is related to changes in the bank's financial condition, as the mix increases following the writing off of problem loans. This phenomenon seems to bias the analysis towards finding an adverse link between the mix and future outcomes. On the other hand, it is also possible that investors permit greater leverage to banks which have a greater ability to recover from distress, implying that any observed relationship between mix and future outcomes does not reflect market discipline, but rationing by the market.[4] I deal with these selection issues using cross-state variation in state corporate income tax rates as an indicator for the presence of subordinated debt in a bank's capital structure. It turns out that there is a strong and robust relationship between corporate tax rates and the mix of debt in regulatory capital, which permits an analysis without concern over these selection issues.

In the end, the analysis documents that the mix of debt in regulatory capital has a positive impact on the future outcomes of banks when investors can impose real constraints on the institution's behavior. In particular, subordinated debt issued by stand-alone banks before the Basel Accord imposed discipline on banks because it typically contained restrictive covenants that protected investors against loss. However, in order to be counted as Tier 2 capital, debt issues no longer contain such restrictions, and consequently, the presence of debt in the capital mix only has adverse impact on future outcomes of the bank. This adverse impact is likely driven by investors refusing to roll over maturing debt issues into new ones, effectively running from the bank with capital, and thereby making its condition worse. At the same time, debt issued by BHC-affiliated institutions is shown to be useful because it mitigates the incentives for the parent to engage in asset substitution. Since a parent with control rights does not need covenants in order to constrain the behavior of an affiliated bank, changes in the capital regime should not

[4] While such rationing would certainly be a form of market discipline, it implies that one cannot extend the results here to make judgments about mandatory debt requirements, which would require all banks to issue debt.

affect the impact of the mix on future behavior. Along these lines, I document that debt issued by BHC-affiliates reduces the probability of future distress and failure throughout the sample. Finally, I document that the debt issued by small bank holding companies has an impact on behavior similar to that issued by stand-alone banks since the Accord. However, debt issues by large bank holding companies appear to have an impact on future behavior consistent with "too-big-to-fail" concerns. In particular, there is no evidence that investors run from debt issued by large bank holding companies in the same way that they run from debt issued by stand-alone banks. Moreover, there is evidence that these institutions engage in moral hazard in the event of distress, as debt is associated with a lower probability of future distress but a higher probability of failure for currently-distressed institutions. I conclude that the presence of debt in regulatory capital can play an important role in disciplining banks, but investors must face the possibility of loss and be able to impose real restrictions on bank behavior.

The paper is organized as follows: the data are described in Section 2; econometric methods are discussed in Section 3; the data are analyzed in Section 4; and Section 5 concludes.

2. Data

This study employs annual December data from the *Call Reports of Income and Condition* which describe the historical balance sheets and income statements of commercial banks over 1976–2004. In addition, I use annual December data on the consolidated reports of bank holding companies from the Y-9C over 1986–2004. Table 1 documents the key variables used in the analysis below.

Regulatory capital is measured as the ratio of equity plus subordinated debt to total assets in line 1, while the capital mix in line 2 is measured as the ratio of subordinated debt to the sum of subordinated debt plus equity. The capital mix is windsorized at 0 and 1 in order to eliminate the influence of a few extreme observations. Line 3 documents that only 5 percent of the bank-years and 18 percent of the BHC-years in the sample have a non-zero mix, while column (3) of line 2 suggests that the average mix of debt in capital for banks (BHCs) with any subordinated debt is equal to 11.77 (17.71) percent.

Figure 1 illustrates the prevalence of subordinated debt in the capital structure of commercial banks and holding companies over the last thirty years. Panel (a) documents that the fraction of banks with debt on their balance sheets peaked in 1980, and is now less than five percent for each of the stand-alone and BHC-affiliated sub-categories. While a little less than 40 percent of bank holding companies used this form of debt in 1986, this fraction has decreased dramatically to just over 10 percent by the end of the period. These time series may suggest a shift by institutions away from subordinated debt, but panel (b) tells a different story. This panel shows that the aggregate amount of debt outstanding for bank holding companies increased from less than $20 billion in 1986 to over $250 billion in 2005. The panel also documents that the debt issued by banks is largely concentrated in BHC-affiliates, which in turn is typically held by a parent and not outside investors. Finally, panel (c) highlights that the mix of debt in regulatory capital for institutions with any subordinated debt is fairly constant over time (at least for bank holding companies and BHC-affiliated banks), accounting for approximately 20 percent of aggregate regulatory capital.

The analysis below uses variation in state-year corporate income tax rates as an instrument for the mix of debt in regulatory capital. Since banks and bank holding companies often operate in different states, I construct an institution's tax rate by weighting each state's effective tax rate with the share of that institution's deposits in the state, using the June *Summary of Deposits* for

Table 1
Summary statistics

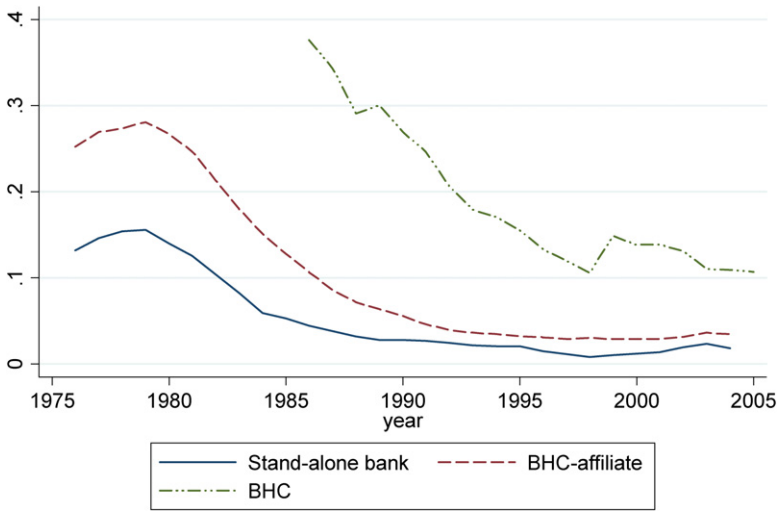
	Bank Sample			BHC Sample		
	Full	Mix = 0	Mix > 0	Full	Mix = 0	Mix > 0
1. Capital/Assets	0.1038	0.1050	0.0818	0.0852	0.0867	0.0777
	(0.0875)	(0.0890)	(0.0465)	(0.0337)	(0.0347)	(0.0270)
	226,258	214,937	11,321	27,239	22,611	4628
2. Capital mix	0.0059	0.0000	0.1177	0.0318	0.0000	0.1771
	(0.0343)	(0.0000)	(0.1018)	(0.1238)	(0.0000)	(0.2442)
	226,259	214,937	11,322	27,557	22,611	4946
3. 1(Capital mix > 0)	0.0500	0.0000	1.0000	0.1795	0.0000	1.0000
	(0.2180)	(0.0000)	(0.0000)	(0.3838)	(0.0000)	(0.0000)
	226,259	214,937	11,322	27,557	22,611	4946
4. MBHC	0.2950	0.2812	0.5570	0.0003	0.0002	0.0006
	(0.4560)	(0.4496)	(0.4968)	(0.0159)	(0.0133)	(0.0246)
	226,259	214,937	11,322	27,557	22,611	4946
5. BHC	0.7259	0.7202	0.8332	0.0028	1.0000	1.0000
	(0.4461)	(0.4489)	(0.3728)	(0.0524)	(0.0000)	(0.0000)
	226,259	214,937	11,322	27,557	22,611	4946
6. log(Assets)	11.0303	10.9393	12.7573	12.8657	12.6418	13.8893
	(1.3304)	(1.2020)	(2.1918)	(1.3334)	(0.9666)	(2.0878)
	226,259	214,937	11,322	27,557	22,611	4946
7. Effective tax rate	0.0594	0.0591	0.0657	0.0619	0.0620	0.0613
	(0.0313)	(0.0314)	(0.0303)	(0.0297)	(0.0295)	(0.0306)
	226,259	214,937	11,322	27,557	22,611	4946
8. Provisions/Assets	−0.0517	0.0017	−1.0603	0.0038	0.0035	0.0050
	(25.3300)	(0.0063)	(113.0109)	(0.0085)	(0.0087)	(0.0073)
	225,110	213,801	11,309	27,540	22,611	4929
9. Net Income/Assets	0.0371	0.0015	0.7115	0.0089	0.0092	0.0072
	(16.9077)	(0.0130)	(75.4347)	(0.0114)	(0.0102)	(0.0156)
	225,110	213,801	11,309	27,557	22,611	4946
10. Securities/Assets	0.2796	0.2835	0.2058	0.2609	0.2681	0.2283
	(0.1564)	(0.1571)	(0.1206)	(0.1238)	(0.1254)	(0.1105)
	226,259	214,937	11,322	27,557	22,611	4946
11. Loans/Assets	0.5522	0.5491	0.6119	0.6072	0.6052	0.6162
	(0.1648)	(0.1653)	(0.1425)	(0.1308)	(0.1319)	(0.1255)
	226,259	214,937	11,322	27,557	22,611	4946
12. Large deposits/Assets	0.1031	0.1031	0.1038	0.1071	0.1076	0.1049
	(0.0808)	(0.0803)	(0.0896)	(0.0675)	(0.0670)	(0.0698)
	226,259	214,937	11,322	27,550	22,607	4943
13. C&I loans/Loans	0.1894	0.1860	0.2549	0.1964	0.1887	0.2318
	(0.1318)	(0.1300)	(0.1473)	(0.1179)	(0.1155)	(0.1220)
	224,072	212,759	11,313	27,557	22,611	4946
14. Consumption loans/Loans	0.1816	0.1802	0.2083	0.1410	0.1356	0.1657
	(0.1439)	(0.1424)	(0.1677)	(0.1106)	(0.1084)	(0.1167)
	224,072	212,759	11,313	27,557	22,611	4946
15. Agriculture loans/Loans	0.1079	0.1115	0.0410	0.0453	0.0486	0.0303
	(0.1659)	(0.1681)	(0.0976)	(0.0928)	(0.0964)	(0.0724)
	224,072	212,759	11,313	27,557	22,611	4946
16. Real estate loans/Loans	0.4987	0.5021	0.4332	0.5889	0.6040	0.5199
	(0.2060)	(0.2058)	(0.1990)	(0.1834)	(0.1799)	(0.1835)
	224,072	212,759	11,313	27,557	22,611	4946

(*continued on next page*)

Table 1 (*continued*)

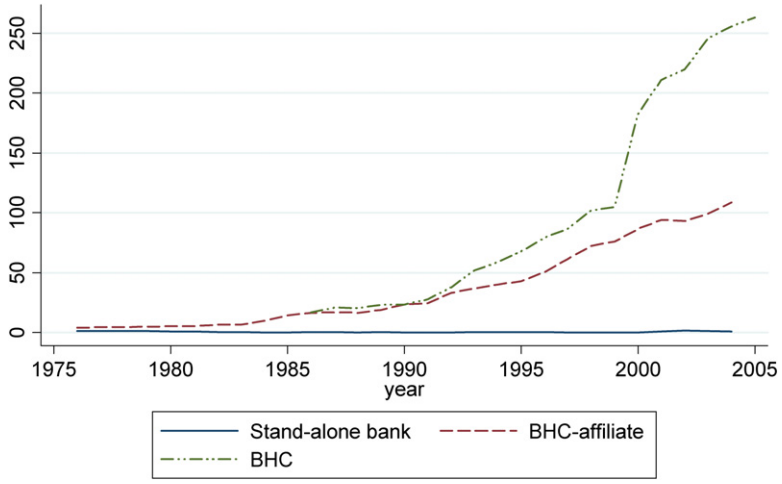
	Bank Sample			BHC Sample		
	Full	Mix = 0	Mix > 0	Full	Mix = 0	Mix > 0
17. Residential mortgages/Loans	0.2571	0.2589	0.2226	0.2196	0.2333	0.1572
	(0.1628)	(0.1634)	(0.1472)	(0.1817)	(0.1812)	(0.1707)
	224,072	212,759	11,313	27,557	22,611	4946
18. Commercial real estate/Loans	0.1390	0.1393	0.1326	0.1757	0.1865	0.1264
	(0.1202)	(0.1208)	(0.1068)	(0.1401)	(0.1397)	(0.1310)
	224,072	212,759	11,313	27,557	22,611	4946
19. Problem loans/Capital	0.1476	0.1433	0.2280	0.1853	0.1753	0.2340
	(7.1872)	(7.3727)	(0.5912)	(8.0628)	(8.8209)	(1.4757)
	226,252	214,937	11,315	27,169	22,571	4598
20. Distress	0.1500	0.1433	0.2772	0.1735	0.1442	0.3077
	(0.3571)	(0.3504)	(0.4476)	(0.3787)	(0.3513)	(0.4616)
	226,259	214,937	11,322	27,557	22,611	4946
21. Pr(Distress in 1 year)	0.1432	0.1366	0.2693	0.1542	0.1339	0.2469
	(0.3503)	(0.3434)	(0.4436)	(0.3611)	(0.3406)	(0.4313)
	208,098	197,726	10,372	25,601	21,008	4593
22. Pr(Failure in next year)	0.0052	0.0051	0.0066	0.0038	0.0036	0.0049
	(0.0719)	(0.0713)	(0.0809)	(0.0616)	(0.0596)	(0.0697)
	218,556	217,477	11,079	25,183	20,469	4714

Notes. The first three columns of the table describe the Bank Sample, which includes annual December observations on Commercial Banks 1984–2004, while the second three columns of the table describe the BHC Sample, which includes annual December observations on Bank Holding Companies 1986–2004. The second and fifth columns report summary statistics for the sub-sample with a zero mix of debt in regulatory capital, while the third and sixth columns report for the sub-sample with non-zero mix. Each line reports the mean over the standard deviation and the number of observations with non-missing values.

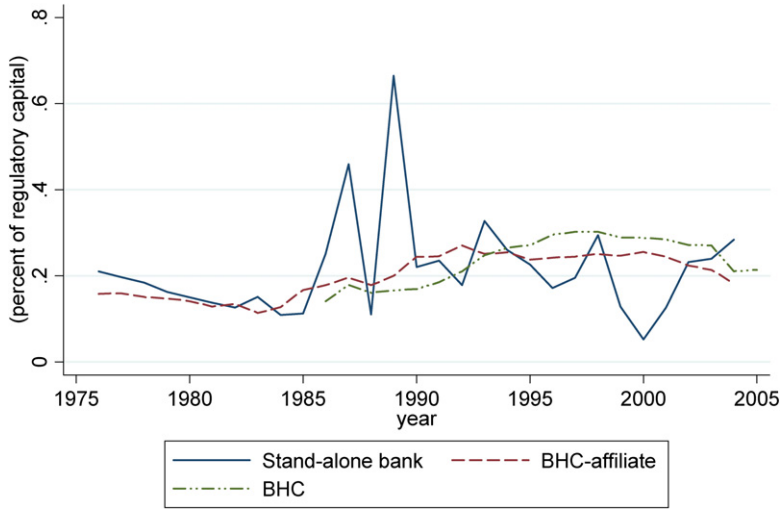


(a) Fraction of institutions with subordinated debt

Fig. 1. Banks and BHCs with subordinated debt.



(b) Subordinated debt outstanding (billions of dollars)



(c) Mix debt for institutions with debt

Fig. 1. *Continued*.

each year of the sample. Line 7 reports effective tax rate on $1 million in corporate profits, and the difference between columns (2) and (3), as well as (5) and (6), illustrates a simple look at the first stage. In particular, banks facing higher state income tax rates tend to have more debt in their capital structure, while BHCs facing higher income tax rates have their leverage limited.[5]

This study uses the fraction of problem loans to capital in order to define financial distress. Problem loans are defined as the sum of loans past due 30–89 days, plus loans past due 90–180 days, plus loans no longer accruing interest. Since bank failures are primarily driven by declines

[5] The balance sheet of the parent largely consists of an equity investment in the subsidiary bank(s) financed by the issue of subordinated debt, implying that debt service is funded with dividends from the equity position. As state corporate income taxes reduce dividends dollar-for-dollar, the first-order effect of taxes on parent leverage is negative.

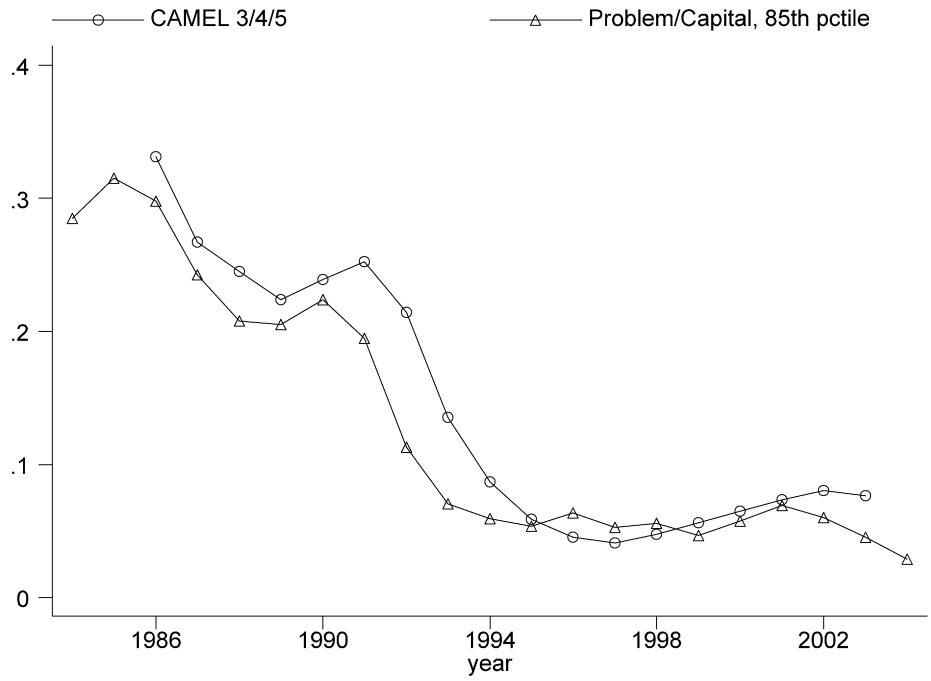


Fig. 2. Financial distress and CAMEL ratings.

in credit quality, and the buffer against future credit losses is capital, this seems to be the key ratio for analyzing bank creditworthiness. Ashcraft (2006) documents that the 85th percentile of this ratio over all bank years (which is approximately equal to 40 percent) closely approximates a CAMEL rating of 3/4/5, as illustrated by Fig. 2. Moreover, using the ratio of problem loans to capital permits the use of more historical data than CAMEL ratings, since the latter are only available starting in 1987, and the underlying data for problem loans is available starting in 1984.

3. Methods

This section describes the econometric methodology implemented in the paper. First, I develop a framework for interpreting the impact of debt in the mix of regulatory capital on the future outcomes of a bank, and motivate the specification used in the analysis. I then develop an estimation strategy which takes into account the likely endogeneity of bank capital mix.

3.1. Empirical framework

It is useful to classify bank financial condition into one of three categories: healthy, distressed, or failed. The fundamental relationship of interest is the impact of the mix of debt in bank capital on the probability of future outcomes of the bank, i.e. on the transition probabilities from the bank's current condition to its condition at the end of next year. The complete impact of debt on future outcomes is summarized through the estimation of four key transition probabilities: the probability that a healthy bank is distressed next year, the probability that a healthy bank

jumps-to-default, the probability that a distressed bank recovers next year, and the probability that a distressed bank fails.

Given the current financial condition of the institution, the sign pattern on these two transition probabilities help one understand why debt has an impact on behavior. In particular, when the mix of debt reduces the probability of future distress but increases the probability of failure, one should conclude that the extra leverage created by the presence of debt only worsens the underlying incentives for moral hazard. However, when the mix of debt reduces both of these probabilities, one should conclude that debt investors are able to impose real constraints on the behavior of the institution that prevent asset substitution, but aid recovery. Finally, when the mix of debt increases the probability of future distress and failure, one should conclude that the presence of debt is counterproductive, as debt investors fail to roll over maturing debt, leaving the bank with less capital and making it more difficult to recover.

The relationship of interest is captured in the analysis below through the following basic equation:

$$\Pr(\text{future outcome} \mid \text{condition})_{i,t+1} = \beta_0 + \beta_1 \text{CAPITAL}_{i,t} + \beta_2 \text{MIX}_{i,t} + \beta_3 \text{X}_{i,t} + \varepsilon_{i,t}. \quad (1)$$

The dependent variable is alternatively a dummy variable indicating distress or failure at the end of the next year. Note that the impact of capital mix ($\text{MIX}_{i,t}$) on future behavior is measured for a given capital ratio ($\text{CAPITAL}_{i,t}$) in order to isolate the impact of the market on bank behavior. The controls ($\text{X}_{i,t}$) include a full set of time fixed effects and all variables listed in Table 1: log bank assets, dummies for BHC and MBHC affiliation (only when using the Bank Sample), the ratio of loans and securities to assets, the ratio of loan portfolio types to total loans, the ratio of large deposits to assets, and the ratio of loan loss provisions and net income to assets. This equation is estimated by Ordinary Least Squares, and all of the reported standard errors are corrected for heteroskedasticity and clustered at the bank level in order to account for dependence across time for each bank.

3.2. Identification

One might reasonably be concerned about the potential endogeneity of bank capital mix. For example, the primary threat to the analysis above is the fact that within-bank variation in the mix is clearly related to its current financial condition, which in turn is related to future financial condition. In particular, as a bank becomes financially distressed, it charges off problem loans against equity, which obviously increases the amount of debt in the mix. To the extent that an increase in the mix simply corresponds to greater financial distress, this creates a bias towards finding adverse effects of debt on future distress. My analysis below avoids bank fixed effects in order to prevent this problem, but that does not mean that this variation disappears from the data. A secondary threat to identification is that the mix of debt is chosen by the bank. If fixed-income investors permit those banks which they feel are better able to recover from financial distress to take more leverage, then any observed benefits of greater subordinated debt might really reflect the greater ability of the banks which issued the debt, and not the actions taken by investors to prevent future distress. Moreover, any change in the returns to debt mix over time could simply reflect the fact that investors have rationed those banks with the worst ability to recover from the market. In order to minimize these problems, one needs to limit the variation in the mix used when estimating the net benefits of subordinated debt.

While finding a valid instrument is often a challenging exercise, there is a natural candidate for isolating plausibly exogenous variation in the mix of debt in regulatory capital. Since interest

on debt is tax-deductible, it follows that cross-sectional variation in state corporate income taxes should generate useful cross-sectional variation in the mix at the bank level. As the instrument focuses the analysis on cross-state variation, it mitigates each of the two aforementioned threats to identification. Note that the use of cross-sectional variation eliminates any within-bank variation in the mix, and there should be no relationship between corporate income tax rates and the ability of a bank to recover from financial distress, other than through the mix.

At the BHC level, the connection between state corporate income tax rates and leverage is more subtle. While taxes also influence the optimal mix of debt in capital, the first-order effect of higher state taxes is to reduce the income that the parent receives from its subsidiary banks through dividends. Since a parent with subsidiaries in high tax states will have a smaller dividend stream with which to service its subordinated debt, it will be compelled to take less leverage as taxes increase. It follows that one expects a negative relationship between taxes and the mix of debt in capital when looking at consolidated BHCs. Furthermore, since the relationship between capital mix and corporate income tax rates works in different directions at the Bank and BHC level, it would be difficult to tell a simple story which dismisses the validity of the empirical strategy.

In order to reduce the dimensionality of very complicated state corporate income tax codes, I focus on the effective tax rate on $1 million in corporate profits. Appendix Table A.1 documents, for each state, the mean effective tax rate over the sample period, as well as the maximum, the minimum, and the time series standard deviation. Note that while there is considerable cross-sectional variation in corporate income tax rates across states, there is very little variation in tax rates within a state over time. It follows that our analysis will not be able to use state fixed effects, implying that our instrument largely consists of cross-sectional variation in state corporate income taxes. As banks and bank holding companies operate in multiple states, an institution's tax rate is constructed using weights on each state in which it operates, equal to its share of deposits in that state (relative to its total deposits) from the June *Summary of Deposits*.

Since 95 percent of the bank-years and 83 percent of the BHC-years in our sample have a mix of zero, it is appropriate to estimate our first stage relationship between the debt mix and effective tax rates using a Tobit model, which is done in Table 2. The first column uses the baseline set of covariates, while the second column uses the extended set of controls. The coefficient in line 1 documents a strong, positive, statistically significant relationship between corporate tax rates and the amount of debt in regulatory capital for commercial banks. The magnitude of the coefficient in column (2) suggests that a 1 percentage point increase in the effective tax rate on $1 million leads to an increase of 0.41 percentage points in the mix, which is large relative to the dependent mean of 59 basis points. On the other hand, for bank holding companies, the coefficient in line 4 documents an equally strong, negative relationship between the tax rate and mix of debt in capital, confirming the premise that the first-order effect of state taxes is to reduce leverage at the parent level. In summary, the first stage appears to be strong and has the right theoretical sign, implying that we have a promising start to dealing with potential threats to identification.

4. Analysis

This section contains the key results of the paper. I start by documenting the empirical linkage between the mix of debt in regulatory capital and the future outcomes of banks and bank holding companies. In order to better understand why the mix of debt affects the future outcomes of these institutions, I investigate how this linkage changes when debt is held by an affiliated parent instead of an outside investor. I then investigate how the impact of debt on behavior has

Table 2
State corporate income tax rates and regulatory capital mix

	Banks		BHCs	
	(1)	(2)	(3)	(4)
1. Effective tax rate	0.5476***	0.4099***	−0.4661***	−0.3626***
	(0.0374)	(0.0379)	(0.0637)	(0.0657)
2. Capital/Assets	−0.0769***	−0.0818***	−0.6233***	−0.4813***
	(0.0254)	(0.0291)	(0.0726)	(0.0747)
3. BHC	−0.0262***	−0.0245***		
	(0.0031)	(0.0031)		
4. MBHC	0.0458***	0.0308***		
	(0.0027)	(0.0027)		
5. Log(assets)	0.0861***	0.0767***	0.0682***	0.0610***
	(0.0010)	(0.0010)	(0.0013)	(0.0015)
6. Observations	226,258	223,035	27,239	27,233
7. Specification	Baseline	Extended	Baseline	Extended

Notes. The sample refers to annual December data on the population of commercial banks 1984–2004 in the first two columns, and bank holding companies 1986–2004 in the second two columns. The table reports estimated coefficients and standard errors from a Tobit model. The baseline specification in columns (1) and (3) includes the ratio of regulatory capital to assets, the mix of subordinated debt in regulatory capital, log bank assets, dummy variables for BHC and MBHC affiliation, the ratio of problem loans to capital, and a full set of time effects. The extended specification in columns (2) and (4) includes controls for asset and loan portfolio composition, the return on assets, the ratio of provisions to assets, and the ratio of time deposits greater than $100,000 to assets.

*** Significant at the 1% level.

changed since the implementation of the Basel Accord, which limited the ability of investors to include restrictive covenants on debt issues. Finally, I study how the link between mix and future outcomes is different across institutions which might be "too-big-to-fail."

4.1. Regulatory capital mix and future financial distress

Table 3 documents a first pass at the relationship between the mix of subordinated debt in regulatory capital, and the probability of future outcomes highlighted in Eq. (1). Panel A uses the Bank Sample 1984–2004, while panel B uses the BHC Sample 1986–2004. The first four columns measure the impact of mix on financial distress in one year, while the second four columns measure the impact on the probability of failure in the next year. For each dependent variable, the first two columns are estimated for the sub-sample of distress bank-years, and the second two columns are estimated for the sub-sample of healthy bank-years. Finally, note that columns (1) and (3) use the actual mix in line 1, while columns (2) and (4) use the mix predicted by corporate income tax rates from Table 2.

Focus first on the impact that the mix has on the probability of future bank distress, in the first line of panel A. When using the actual mix, there is evidence that this increase in leverage tends to be associated with adverse outcomes for the bank. However, there is evidence that selection bias is significant, as an increase in the mix, predicted by an increase in corporate income tax rates, has a significantly positive impact on future outcomes by reducing the probability of future distress and failure. The sign of this bias suggests that increases in the mix are typically associated with a deterioration in the bank's financial condition. By focusing on variation in the mix that is unrelated to the bank's condition, we are measuring the impact of a plausibly exogenous increase

Table 3
Capital mix and future outcomes

Estimator	Pr(Financial distress in 1 year)				Pr(Failure in next year)			
Condition	Distressed		Healthy		Distressed		Healthy	
Mix	Actual	Predict	Actual	Predict	Actual	Predict	Actual	Predict
A. Commercial Banks (1984–2004)								
1. Mix	0.123**	−0.741***	0.099***	−0.427***	0.052*	−0.229***	0.000	−0.090***
	(0.056)	(0.233)	(0.026)	(0.056)	(0.030)	(0.069)	(0.007)	(0.012)
2. Capital	−1.641***	−1.673***	−0.250***	−0.274***	−1.078***	−1.088***	−0.101***	−0.107***
	(0.151)	(0.150)	(0.018)	(0.019)	(0.087)	(0.087)	(0.008)	(0.009)
3. ln(assets)	0.019***	0.078***	−0.009***	0.025***	−0.005***	0.013**	−0.001**	0.006***
	(0.003)	(0.018)	(0.001)	(0.004)	(0.001)	(0.005)	(0.000)	(0.001)
4. *N*	31,283	31,283	173,990	173,990	33,590	33,590	181,910	181,910
B. Bank Holding Companies (1986–2004)								
1. Mix	0.059	−1.514**	0.044	0.323*	0.085*	0.315	−0.015	0.091**
	(0.097)	(0.749)	(0.040)	(0.175)	(0.049)	(0.193)	(0.019)	(0.040)
2. Capital	−1.178***	−1.878***	−0.234**	−0.086	−0.350**	−0.223	0.081**	0.120***
	(0.401)	(0.556)	(0.104)	(0.131)	(0.138)	(0.168)	(0.039)	(0.044)
3. ln(assets)	0.011*	0.103**	−0.009***	−0.027**	−0.002	−0.021*	0.000	−0.006**
	(0.006)	(0.046)	(0.002)	(0.011)	(0.002)	(0.012)	(0.000)	(0.002)
4. *N*	3884	3884	21,125	21,125	4211	4211	20,654	20,654

Notes. The sample refers to annual December data on the population of commercial banks 1984–2004 in panel A and bank holding companies 1986–2004 in panel B. The first four columns of the table report marginal effects from a Probit model, while the last four columns report estimates from a linear probability model. The dependent variable is a dummy indicating financial distress at the end of next year, while regressors include those listed in each panel, control variables listed in Table 1, and a full set of time effects. Standard errors are corrected for heteroskedasticity and clustered at the bank level. Columns (1), (2), (5), and (6) refer to bank-years of financial distress, defined as institution with ratio of problem loans to equity is larger than the 85th percentile of all bank-years, while other columns refer to healthy bank-years.

* Significant at the 10% level.
** Idem, 5%.
*** Idem, 1%.

in bank leverage on behavior. Together, these results suggest that subordinated debt issued by banks is effective in limiting moral hazard.

The measured benefit of debt capital is larger for distressed banks in column (2) than for healthy banks in column (4), but it is noteworthy that the mix of debt has a strong effect in preventing future financial distress, regardless of current financial condition. As far as economic magnitudes, the marginal effect in column (2) suggests that a 10 percentage point increase in the mix of debt reduces the probability of future distress by 7.41 percentage points, which is small relative to the mean of the dependent variable [61.02%]. However, note that the impact of regulatory capital is also economically small, as a one percentage point increase in the capital ratio reduces the probability of future distress for a currently-distressed bank by only 1.67 percent. In this context, a 4.25 percentage point increase in regulatory capital has approximately the same measured effect as a 10 percentage point increase in the mix of debt in preventing future distress for currently-distressed institutions.[6]

[6] Lines 3 and 4 of the table document that a bank affiliated with a holding company, in either the one-bank and multi-bank flavor, has an advantage in recovering from financial distress and in preventing a transition into financial distress, a fact documented by Ashcraft (2006). Line 5 documents that log bank size tends to increase inertia, as it increases the

Panel B of Table 3 documents, in the first and third columns, that there is little link between the actual capital mix for BHCs and future outcomes over the full sample. Not only is the coefficient on mix in line 1 no different from zero statistically, it is also one-fifth the size of the same coefficient in panel A, implying that this no-result is not driven by the lower statistical power of a smaller sample. However, the second and fourth columns document that selection bias is also important at the consolidated BHC level. For currently distressed BHCs, as with banks, the impact of capital mix on the probability of future distress is also negative, but the magnitude is almost twice as large. In particular, the estimated coefficient indicates that an increase in the mix by 10 percentage points reduces the probability that a currently-distressed institution is distressed one year in the future by 15.14 percentage points in column (2). Interestingly, there is some statistically weak evidence that the mix of debt has an adverse effect on the transition of healthy BHCs into distress in column (4), and also has an adverse effect on the transition of bank holding companies into failure in column (8). This sign pattern, in columns (2) and (6), is consistent with moral hazard, although the latter coefficient is not statistically different from zero. However, the magnitude of these effects, in line 1, is similar to that on regulatory capital in line 2, suggesting that the link is economically important.

In summary, instrumental variables estimates suggest that the mix of debt in regulatory capital has an important impact on the future outcomes of both distressed and healthy banks. However, there is also evidence that debt has a different impact on bank behavior when it is issued by a bank holding company instead of a commercial bank. I now work to better understand these differences.

4.2. The capital mix of commercial banks across BHC-affiliation

In order to better understand whether or not discipline measured in panel A of Table 3 is being imposed on the institution by investors or by the bank itself, it seems sensible to investigate the differential impact of debt issued by banks across BHC-affiliation. Since debt issued by a subsidiary bank is likely held by a parent, one might be skeptical whether selling debt to an affiliated institution would ever impose meaningful constraints on behavior. That said, it seems plausible that the discipline which debt investors impose on a bank is significantly different when these investors are also equity holders of the bank, as is typically the case for a BHC-affiliated bank. One might argue that a parent company with a debt position in a subsidiary bank might have a greater ability to discipline a subsidiary bank, as compared to a stand-alone institution with the same amount and mix of capital. In particular, while a stand-alone bank has the incentive to transfer wealth away from debt investors through asset substitution as the bank condition deteriorates, a BHC-affiliated bank would face reduced incentives to engage in such moral hazard, because it would only be stealing from itself. Alternatively, it seems reasonable to assert that outside investors have less information about a stand-alone bank than a parent holding company has about a subsidiary bank's condition. It follows that stand-alone bank debt investors might respond more severely to a change in condition, demanding higher spreads or more severe covenants for future debt issues. This information premium could undermine the ability of the stand-alone bank to recover, and implies that debt issued by a BHC-affiliate would be better for the future outcomes of the bank.

probability that a distressed bank remains distressed and the probability that a healthy bank remains healthy. The final four columns of the table document that these results are robust to the linear probability model.

Table 4
BHC-affiliation and future outcomes

Estimator	Pr(Financial distress in 1 year)				Pr(Failure in next year)			
Condition	Distressed		Healthy		Distressed		Healthy	
Mix	Actual	Predict	Actual	Predict	Actual	Predict	Actual	Predict
A. Stand-Alone Banks								
1. Mix	0.113	−0.420	0.128**	−0.198*	0.111*	−0.154	−0.010	−0.132***
	(0.089)	(0.420)	(0.057)	(0.107)	(0.059)	(0.136)	(0.007)	(0.025)
2. Capital	−1.286***	−1.311***	−0.298***	−0.308***	−0.985***	−1.000***	−0.120***	−0.128***
	(0.208)	(0.207)	(0.026)	(0.027)	(0.145)	(0.145)	(0.012)	(0.013)
3. ln(assets)	0.007	0.041	−0.015***	0.001	−0.009***	0.004	−0.003***	0.007***
	(0.007)	(0.034)	(0.002)	(0.009)	(0.002)	(0.011)	(0.001)	(0.002)
4. *N*	9652	9652	47,768	47,768	10,296	10,296	49,050	49,050
B. BHC-Affiliates								
1. Mix	0.122*	−0.760***	0.075***	−0.492***	0.017	−0.263***	−0.003	−0.077***
	(0.070)	(0.280)	(0.028)	(0.063)	(0.032)	(0.079)	(0.008)	(0.012)
2. Capital	−1.988***	−2.012***	−0.222***	−0.249***	−1.175***	−1.183***	−0.082***	−0.087***
	(0.199)	(0.199)	(0.024)	(0.023)	(0.084)	(0.084)	(0.011)	(0.011)
3. ln(assets)	0.020***	0.081***	−0.007***	0.031***	−0.005***	0.016**	0.000	0.006***
	(0.003)	(0.022)	(0.001)	(0.005)	(0.001)	(0.006)	(0.000)	(0.001)
4. *N*	21,631	21,631	126,222	126,222	23,294	23,294	132,860	132,860

Notes. The sample refers to annual December data on the population of commercial banks 1984–2004 for each of two sub-samples listed by panel. See also Notes Table 3.

* Significant at the 10% level.
** Idem, 5%.
*** Idem, 1%.

In order to better understand which of these factors is more important, I reconsider the linkage between capital mix and the future outcomes of banks documented in Table 4, breaking out the analysis of banks from panel A of Table 3 across BHC-affiliation. Panel A documents that there is weak connection between the capital mix and future outcomes of stand-alone banks. In particular, there is a significantly reduced probability that healthy banks become distressed or fail. Panel B documents a stronger connection between capital mix and future outcomes of BHC-affiliates. While each of the estimated coefficients on predicted mix in line 1 is statistically different from zero, each is not statistically different from the same coefficient reported in panel A for stand-alone banks.

These results have several important conclusions. First, the impact of mix on future outcomes of a commercial bank is positive, for both stand-alone and BHC-affiliated banks. Since the predicted mix is a plausibly exogenous change in bank leverage, this result challenges conventional wisdom on the importance of moral hazard incentives of distressed banks. According to the Merton model, leverage and risk are complements. However, the above described data reject this model decisively, at least for commercial banks that issue subordinated debt. Second, there is evidence that one does not actually need a price or a market in order for debt capital to impose discipline on the institution. This is evidenced by the fact that debt issued by BHC-affiliated banks tends to have the same or larger benefits as that issued by stand-alone banks. The main open question is whether or not the discipline that one observes is driven by the direct control that investors have over bank behavior, or if the bank imposes limits on its own behavior.

4.3. The Basel Accord and the capital mix of commercial banks

Debt investors attempt to prevent asset substitution by distressed borrowers through the imposition of restrictive covenants on behavior. A recent study by Goyal (2005) documents that restrictive covenants included on subordinated debt issues were sensitive to bank charter value, especially during the 1980s when the banking industry was severely distressed. However, the original Basel Accord implemented in 1990 severely limited the ability of debt investors to constrain bank behavior. In particular, in order to be counted as Tier 2 capital, a subordinated bond may not have restrictive covenants, must permit the suspension of dividends in the event of distress, and must have a minimum maturity of five years.[7]

In principle, these changes in the regulatory capital regime should only affect the ability of debt investors to discipline stand-alone banks. In particular, a parent holding company does not need covenants in order to discipline the bank, since it already has control through its equity position in the subsidiary. However, restrictive covenants are the only defense that investors in stand-alone banks have against moral hazard. In order to study whether changes in the importance of covenants had a differential impact on the benefits of debt in the capital mix across BHC-affiliation, I break out the analysis from Table 4 across capital regimes in Table 5: stand-alone banks before the Accord in panel A; stand-alone banks after the Accord in panel B; BHC-affiliated banks before the Accord in panel C; BHC-affiliated banks since the Accord in panel D.

Panel A documents that predicted mix of debt in capital had a strong disciplinary impact on future outcomes, for both distressed and healthy stand-alone banks during the 1980s. However, panel B documents that this impact has disappeared in the more recent sub-sample, and that now, debt only has an adverse impact on the probability of future distress or failure. The sign pattern does not suggest that distressed institutions now engage in moral hazard, as there is no evidence of an upside. As suggested above, it is likely that distressed stand-alone banks are unable to roll-over maturing debt capital, making it more difficult to recover from distress. Moreover, this mechanism could make it more likely for a healthy stand-alone bank to become distressed at the first sign of trouble. Interestingly, these results contrast sharply to those for BHC-affiliated institutions, where the mix of debt had, and continues to have, a beneficial impact on future outcomes throughout the sample.

Together, these results help us fully understand that debt in the capital mix only has an impact on bank behavior when investors have real control over bank behavior. In particular, debt issued to outside investors can impose discipline, but only when those investors can include restrictive covenants on behavior.

Moreover, it appears that debt issued to inside investors can impose discipline on the institution by mitigating the moral hazard incentives of equity holders.

[7] [12CFR250.166] "To be included in Tier 2 capital under the Board's risk-based capital guidelines for state member banks and bank holding companies, subordinated debt must be subordinated in right of payment to the claims of the issuer's general creditors \1\ and, for banks, to the claims of depositors as well; must be unsecured; must state clearly on its face that it is not a deposit and is not insured by a federal agency; must have a minimum average maturity of five years; \2\ must not contain provisions that permit debtholders to accelerate payment of principal prior to maturity except in the event of bankruptcy of or the appointment of a receiver for the issuing organization; must not contain or be covered by any covenants, terms, or restrictions that are inconsistent with safe and sound banking practice; and must not be credit sensitive."

4.4. The capital mix and bank holding company size

In principle, the control rights of investors that purchase debt issued by bank holding companies are similar to those issued by stand-alone banks. It follows that one might expect to see a similar relationship between the estimated transition probabilities and bank capital mix. However, one might be concerned about the impact of the perception that large institutions are "too-big-to-fail." In particular, investors in debt issued by large bank holding companies should be more likely to roll over debt, and will increase spreads by less as the institution becomes financially distressed. Depending on the amount of franchise value, the impact of mix in "too-big-to-fail" institutions could either be moral hazard or have no impact at all.

In order to study these issues, I break panel B of Table 3 up into two samples across institution size in Table 6, using the 90th percentile of assets across all BHC-years in order to identify large holding companies. The estimated coefficients on predicted mix for small bank holding companies, in panel B, look most similar to those for stand-alone banks since the Basel Accord, from panel B of Table 5. The adverse impact of debt is not quite as severe for distressed small bank holding companies as it is for distressed stand-alone banks, but the coefficients are estimated too imprecisely to make much of this. Interestingly, the sign pattern from panel A of the table suggests that large bank holding companies engage in moral hazard when distressed, with a lower probability of future distress and higher probability of failure. However, there does not appear to be any impact of mix on the transition probabilities for large healthy bank holding companies. This evidence is consistent with the story that franchise value keeps large institutions in check when healthy, but "too-big-to-fail" attitudes permit these institutions to gamble when distressed.[8]

5. Conclusions

This paper studies the impact of plausibly exogenous changes in leverage on the future outcomes of banks and bank holding companies. I am able to isolate the impact of the market on the behavior of these institutions by exploiting a zone of indifference that regulators have about the mix of subordinated debt in regulatory capital. I document strong evidence that investors are able to discipline banks, but only when they have control over bank behavior, either through restrictive covenants or an equity position in the bank. These results highlight two important policy issues.

First, there is robust evidence that the issuance of debt capital by a subsidiary bank only improves the future outcomes of the institution. Distressed subsidiaries with debt are less likely to fail and more likely to recover, and healthy subsidiaries with debt capital have better outcomes than healthy subsidiaries without debt. It follows that forcing a parent to take both debt and equity positions in a subsidiary should mitigate incentives for moral hazard, and improve the future outcomes of the institution.

Second, as bank regulators insist that subordinated debt be issued without restrictive covenants in order to be counted as capital, one might view this requirement as an important barrier to heavier involvement of outside investors in the regulation of banks. I document evidence suggesting that outside investors lacking such protections are more likely to run in the event of distress, by not rolling over their debt, making it both more difficult for stand-alone banks and small bank

[8] While it would certainly be interesting to split the sample across capital regimes, this is unfortunately not feasible given that the short sample for bank holding companies before the Basel Accord reduces statistical power to a level that makes such an exercise uninformative.

Table 5
BHC-affiliation and Basel

Estimator	Pr(Financial distress in 1 year)				Pr(Failure in next year)			
Condition	Distressed		Healthy		Distressed		Healthy	
Mix	Actual	Predict	Actual	Predict	Actual	Predict	Actual	Predict
A. Stand-Alone Banks before Basel								
1. Mix	0.219**	−0.859*	0.135	−0.508***	0.107*	−0.323*	−0.012	−0.249***
	(0.095)	(0.459)	(0.086)	(0.179)	(0.063)	(0.169)	(0.021)	(0.050)
2. Capital	−1.586***	−1.654***	−0.487***	−0.518***	−1.503***	−1.533***	−0.279***	−0.296***
	(0.254)	(0.253)	(0.049)	(0.051)	(0.131)	(0.131)	(0.030)	(0.031)
3. ln(assets)	−0.006	0.063*	−0.020***	0.021	−0.013***	0.014	−0.007***	0.013***
	(0.008)	(0.037)	(0.003)	(0.014)	(0.003)	(0.014)	(0.001)	(0.004)
4. *N*	6915	6915	22,935	22,935	7382	7382	23,476	23,476
B. Stand-Alone Banks after Basel								
1. Mix	−0.718**	0.560***	0.096**	0.309***	−0.040	0.462***	0.007	0.001
	(0.275)	(0.910)	(0.059)	(0.104)	(0.080)	(0.169)	(0.015)	(0.016)
2. Capital	−0.939***	−0.929***	−0.214***	−0.197***	−0.345***	−0.324***	−0.023***	−0.023***
	(0.327)	(0.329)	(0.023)	(0.024)	(0.127)	(0.128)	(0.006)	(0.006)
3. ln(assets)	0.030***	−0.016***	−0.009***	−0.033***	−0.002	−0.039***	0.000	0.000***
	(0.011)	(0.074)	(0.002)	(0.008)	(0.003)	(0.014)	(0.000)	(0.001)
4. N	2737	2737	24,833	24,833	2914	2914	25,574	25,574
C. BHC-Affiliated Banks before Basel								
1. Mix	0.152**	−1.356***	0.137**	−0.438***	0.002	−0.361***	0.007	−0.084***
	(0.075)	(0.209)	(0.060)	(0.085)	(0.036)	(0.059)	(0.020)	(0.017)
2. Capital	−2.173***	−2.236***	−0.453***	−0.474***	−1.348***	−1.359***	−0.186***	−0.191***
	(0.223)	(0.222)	(0.059)	(0.060)	(0.117)	(0.118)	(0.029)	(0.030)
3. ln(assets)	0.018***	0.129***	−0.011***	0.025***	−0.007***	0.022***	−0.001***	0.006***
	(0.003)	(0.017)	(0.002)	(0.007)	(0.001)	(0.005)	(0.000)	(0.001)
4. *N*	15,752	15,752	44,179	44,179	16,933	16,933	46,158	46,158
D. BHC-Affiliated Banks after Basel								
1. Mix	−0.132	−1.119***	0.025	−0.138***	0.045	−0.231***	−0.003***	−0.004
	(0.186)	(0.401)	(0.021)	(0.034)	(0.080)	(0.062)	(0.001)	(0.003)
2. Capital	−1.491***	−1.528***	−0.174***	−0.181***	−0.756***	−0.753***	−0.014***	−0.015***
	(0.378)	(0.377)	(0.016)	(0.016)	(0.113)	(0.112)	(0.004)	(0.004)
3. ln(assets)	0.009	0.097***	−0.007***	0.004	−0.003**	0.016***	0.000	0.000
	(0.006)	(0.032)	(0.001)	(0.003)	(0.001)	(0.005)	(0.000)	(0.000)
4. *N*	5879	5879	82,043	82,043	6361	6361	86,702	86,702

Notes. The sample refers to annual December data on the population of commercial banks 1984–2004 for each of two sub-samples listed by panel. See also Notes Table 3.

* Significant at the 10% level.
** Idem, 5%.
*** Idem, 1%.

holding companies to recover from distress, and more likely for them to fall into distress. Moreover, there is evidence that stripping the investors in the debt of large bank holding companies of this authority has an even worse effect, as these institutions engage in moral hazard when distressed. This latter result suggests that bank regulators could use some help in disciplining large bank holding companies in the event of distress. Requiring bank holding companies to put restrictive covenants into their subordinated debt issues would be a nice place to start.

Table 6
Capital Mix and Future Outcomes across BHC size

Estimator	Pr(Financial distress in 1 year)				Pr(Failure in next year)			
Condition	Distressed		Healthy		Distressed		Healthy	
Mix	Actual	Predict	Actual	Predict	Actual	Predict	Actual	Predict
A. Large Bank Holding Companies								
1. Mix	−0.357	−6.639***	−0.154**	−0.199	0.093	1.466*	−0.055***	−0.034
	(0.228)	(2.210)	(0.061)	(0.585)	(0.058)	(0.748)	(0.017)	(0.138)
2. Capital	−0.765	−3.788***	0.140	−0.033	0.563**	1.254***	0.269***	0.227**
	(0.565)	(0.962)	(0.283)	(0.391)	(0.226)	(0.335)	(0.088)	(0.110)
3. ln(assets)	0.043**	0.433***	0.000	0.006	−0.001	−0.087*	0.001	0.001
	(0.019)	(0.135)	(0.005)	(0.037)	(0.006)	(0.045)	(0.001)	(0.008)
4. *N*	434	434	2127	2127	476	476	2105	2105
B. Small Bank Holding Companies								
1. Mix	0.137	−0.975	0.083	0.378**	0.060	0.179	−0.007	0.104**
	(0.107)	(0.797)	(0.055)	(0.187)	(0.054)	(0.201)	(0.028)	(0.042)
2. Capital	−1.307***	−1.803***	−0.289***	−0.116	−0.452***	−0.387**	0.060	0.106**
	(0.465)	(0.641)	(0.092)	(0.126)	(0.148)	(0.183)	(0.037)	(0.042)
3. ln(assets)	0.004	0.064	−0.014***	−0.036***	0.001	−0.009	0.000	−0.006**
	(0.012)	(0.051)	(0.003)	(0.012)	(0.003)	(0.013)	(0.001)	(0.003)
4. *N*	3450	3450	18,998	18,998	3735	3735	18,549	18,549

Notes. The sample refers to annual December data on the population of bank holding companies 1986–2004 for each of four sub-samples listed by panel. See also Notes Table 3.

* Significant at the 10% level.
** Idem, 5%.
*** Idem, 1%.

Appendix A

Table A.1
Effective state corporate income tax on $1 million in business profits

State	Mean	Max	Min	Sd	State	Mean	Max	Min	Sd
AK	0.0898	0.0898	0.0898	0.0000	MT	0.0689	0.0750	0.0675	0.0028
AL	0.0500	0.0500	0.0500	0.0000	NC	0.0706	0.0775	0.0600	0.0065
AR	0.0608	0.0622	0.0593	0.0015	ND	0.0974	0.1030	0.0300	0.0203
AZ	0.0967	0.1047	0.0800	0.0084	NE	0.0717	0.0771	0.0656	0.0059
CA	0.0925	0.0960	0.0884	0.0020	NH	0.0774	0.0825	0.0700	0.0047
CO	0.0533	0.0598	0.0500	0.0040	NJ	0.0911	0.1046	0.0900	0.0041
CT	0.1121	0.1150	0.0950	0.0061	NM	0.0848	0.1080	0.0480	0.0126
DC	0.0996	0.1000	0.0950	0.0014	NV	0.0000	0.0000	0.0000	0.0000
DE	0.0870	0.0870	0.0870	0.0000	NY	0.0908	0.1000	0.0900	0.0028
FL	0.0550	0.0550	0.0550	0.0000	OH	0.0889	0.0910	0.0871	0.0020
GA	0.0600	0.0600	0.0600	0.0000	OK	0.0554	0.0600	0.0500	0.0052
HI	0.0629	0.0642	0.0628	0.0004	OR	0.0667	0.0750	0.0660	0.0025
IA	0.1118	0.1118	0.1118	0.0000	PA	0.0998	0.1225	0.0850	0.0152
ID	0.0798	0.0800	0.0770	0.0008	RI	0.0869	0.0900	0.0800	0.0048
IL	0.0462	0.0480	0.0400	0.0035	SC	0.0523	0.0600	0.0500	0.0044
IN	0.0337	0.0340	0.0300	0.0011	SD	0.0000	0.0000	0.0000	0.0000
KS	0.0423	0.0450	0.0400	0.0026	TN	0.0600	0.0600	0.0600	0.0000

Table A.1 (*continued*)

State	Mean	Max	Min	Sd	State	Mean	Max	Min	Sd
KY	0.0714	0.0767	0.0581	0.0063	TX	0.0000	0.0000	0.0000	0.0000
LA	0.0755	0.0755	0.0755	0.0000	UT	0.0500	0.0500	0.0500	0.0000
MA	0.0814	0.0950	0.0240	0.0259	VA	0.0620	0.0861	0.0600	0.0072
MD	0.0700	0.0700	0.0700	0.0000	VT	0.0809	0.0939	0.0600	0.0085
ME	0.0818	0.0818	0.0818	0.0000	WA	0.0000	0.0000	0.0000	0.0000
MI	0.0303	0.1176	0.0220	0.0262	WI	0.0790	0.0790	0.0790	0.0000
MN	0.0932	0.0980	0.0501	0.0130	WV	0.0910	0.0975	0.0695	0.0072
MO	0.0566	0.0625	0.0500	0.0064	WY	0.0000	0.0000	0.0000	0.0000
MS	0.0483	0.0499	0.0300	0.0055					

Notes. The data refer to annual state corporate income tax data, and cover 1986–1998. The table reports summary statistics for the effective tax rate on $1 million in business profits for each state over the time period.

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