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The cost of market versus regulatory discipline in banking[1]

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Abstract

We present evidence that insured deposit financing shields banks from the full costs of market discipline. Moody's downgrades, indicators of increasing risk, are associated with negative abnormal equity returns that are increasing in the bank's reliance on insured deposits. Moreover, banks raise their use of insured deposits following increases in risk. These findings cast doubt on the ability of capital market participants to effectively discipline bank behavior within the current regulatory environment. More generally, our findings highlight the potential for regulation to undermine market discipline in regulated industries.

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1. Introduction

Under the current regulatory environment, U.S. commercial banks face a combination of regulatory discipline and market discipline. Combined, these

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two forms of discipline determine a bank's cost of risk taking. Markets penalize banks for increasing risk by increasing the costs of debt financing and by limiting the types of claims a bank may issue. At the same time, regulators impose discipline through risk-based capital requirements and insurance premiums, examination frequency and intensity, and cease and desist orders. While empirical studies of bank market discipline suggest risk premia exist for uninsured bank liabilities, there has been no examination of how the costs of regulatory and market discipline combine to influence a bank's overall preference for risk.[2]

If the costs of regulatory and market discipline differ, then in times of changing risk banks will have an incentive to substitute towards the cheaper one. This substitution may be accomplished by varying the bank's reliance on insured deposits relative to uninsured liabilities. Results indicate that bank shareholders perceive the costs associated with regulatory discipline to be less sensitive to risk increases than the costs associated with market discipline. We find that banks actively exploit this perceived difference by increasing their reliance on insured deposit funding in times of increasing risk. The disparate costs of insured deposits and uninsured liabilities, combined with the ability and willingness of banks to alter their exposure to each, challenge the notion that market discipline can be an effective deterrent against excessive risk taking.

To measure the relative costs of bank exposure to market and regulatory discipline, we conduct two sets of tests. First, we examine the relationship between banks' use of insured deposits and the cost to shareholders of an increase in risk, measured as the abnormal return to a Moody's downgrade announcement.[3] We find that downgraded banks with larger insured deposit bases (relative to total liabilities) experience smaller declines in equity value. Second, we examine the change in banks' reliance on insured deposits in periods surrounding Moody's downgrades. Downgraded banks increase their reliance on insured deposits, both in relative and absolute terms, indicating that bank managers perceive the costs of insured deposits to have increased less than the costs of uninsured liabilities. Hence, the market's ability to discipline is diminished by the relatively low cost of insured deposits and the ability of banks to substitute these claims for market priced liabilities.

[2] See, for example, Hannan and Hanweck (1988), Ellis and Flannery (1992), and James (1990) for an analysis of negotiable CD rate spreads. Avery et al. (1988), Gorton and Santomero (1990), and Flannery and Sorescu (1996) examine subordinated note and debenture (SND) yield spreads.

[3] In most cases, the equity response is that of the bank holding company which owns the bank. We relate that response to the deposit characteristics of the bank affiliates of the holding company (see Section 3). Henceforth, we will refer to the bank's equity price reaction.

These findings call into question the ability of markets to exact meaningful penalties on risk-increasing banks. Moreover, market discipline is weakest where regulators arguably need it the most, for banks that rely most heavily on insured deposit funding. There are several potential regulatory policy changes that might enable market discipline to deter bank risk-taking more effectively. Such changes would involve restricting the ability of banks to alter their exposure to market versus regulatory discipline. For example, regulators could require minimum levels of uninsured liabilities, restrict the substitution of insured for uninsured claims, and enforce higher risk-based insurance premia specifically linked to insured deposits. Implementation of these policy changes may have other effects unrelated to increasing the role of markets in disciplining bank behavior. However, without significant regulatory reform, market discipline may be relatively ineffective in controlling bank risk taking.

The rest of the paper is organized as follows. Section 2 presents our empirical design and places our work in the context of previous bank market discipline studies. In Section 3, we describe our data. We present our primary results on bank equity responses to Moody's long term credit rating downgrades in Section 4. Section 5 contains our analysis of changes in bank holding companies' relative use of insured and market claims in response to Moody's downgrades. Section 6 concludes.

2. Empirical plan and previous evidence

The existence of market discipline implies that required rates of return on market priced liabilities will respond to changes in bank risk. We test whether the current regulatory structure compromises the extent to which market discipline deters bank risk-taking by examining the equity response and the change in insured deposit use associated with changes in bank risk. We examine Moody's debt rating downgrades as proxies for discrete changes in bank risk. A downgrade signals that the rating agency perceives an increase in the probability that a firm will default on its debt. Downgrades indicate increased risk to liability holders and result in increased future uninsured debt financing costs. While this increase in future financing costs has a negative effect on equity values, the total effect of downgrades on shareholders may be positive, negative, or zero. For example, some downgrades are prompted by firm actions which expropriate wealth from debtholders to stockholders, such as increases in leverage or asset volatility. In these cases, the total effect on shareholders will depend on the relative magnitudes of increased financing costs and expropriation benefits. Downgrades not characterized by expropriation, for reasons such as deterioration in overall firm financial health, should have a strictly negative effect on shareholders. Goh and Ederington (1993) provide a detailed discussion and empirical treatment of these issues.

We assume that downgrades are associated with increased future financing costs on market-priced liabilities. If shareholders bear these increased costs, then the cost increases will deter risk taking. Moreover, given that regulators monitor changes in bank risk, it is reasonable to expect that the all-in cost of insured deposits will also rise as a bank's risk increases.

The current regulatory structure imposes risk related costs on a bank. The major regulatory cost mechanisms such as risk-based deposit insurance, risk-based capital standards and regulator monitoring are largely invariant to a bank's use of insured versus uninsured liabilities.[4] Consequently, regulator imposed costs can be thought of as manifesting themselves in higher costs on *both* insured deposits and uninsured liabilities. In contrast, market imposed costs of risk are borne solely by uninsured liability holders. Thus, unless other significant regulatory costs exist which discriminate between insured deposit and uninsured liability use, increases in bank risk will lead to a greater rise in the cost of uninsured liabilities than in the cost of insured deposits.

Given this regulatory environment, the total cost a bank incurs for an increase in risk declines in the bank's reliance on insured deposit versus uninsured liability funding. Downgraded banks relying more heavily on uninsured claims will endure higher future financing costs on these liabilities and/or be forced to incur the costs of substituting into insured deposits. Costly substitution into insured deposits is analogous to the adjustment costs incurred on retail bank deposits in Flannery's (1982) model. Assuming that increased future financing costs will be impounded in current equity values, we hypothesize that downgraded banks using relatively more insured deposits should endure less negative abnormal announcement returns than downgraded banks using relatively more uninsured liabilities. We also hypothesize that bank managers will respond to increases in risk by altering their financing mix in favor of insured deposits as they become relatively cheaper than uninsured liabilities.

Fig. 1 graphically illustrates this argument. Adopting the basic structure of Klein's model (1971), we assume a bank optimally equates its marginal revenue on loans to its marginal cost of raising loanable funds. The bank has two sources of loanable funds, insured deposits and uninsured liabilities. The bank's marginal cost curve for insured deposits, r_{I,σ_L}, is upward sloping, consistent with an

[4] Deposit insurance premia are assessed on total domestic deposits. Thus, these costs are invariant to a bank's reliance on insured versus uninsured deposits, but will increase the cost of insured deposits relative to non-deposit uninsured liabilities. Deposit insurance premia are assessed semi-annually and vary between zero and 27 basis points (per year) depending on the bank's capital level and supervisory rating. As of December 31, 1996, 95% of all banks were in the zero basis point category. Only 85 of the 9852 insured commercial banks paid more than 10 basis points. Risk based capital standards depend on the composition of all bank assets. While regulatory monitoring likely increases with overall risk, we are unaware of any evidence that suggests reporting requirements, examination frequency, or degree of scrutiny vary with the use of insured deposits.

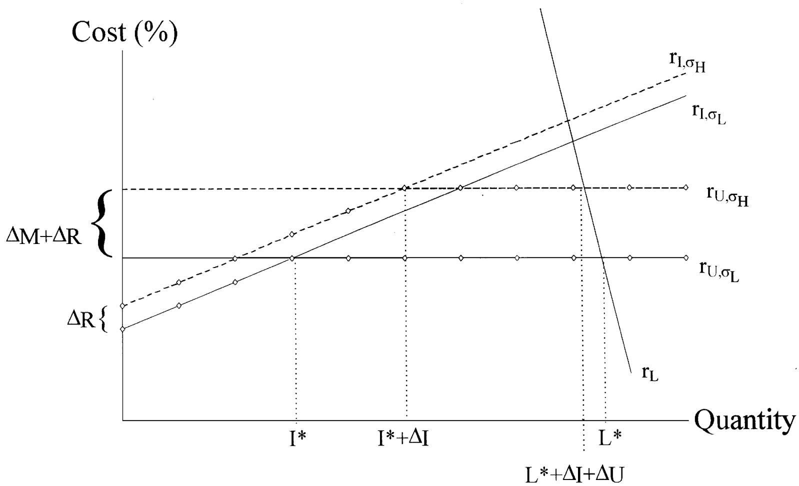

Fig. 1. ΔR is the increase in the regulatory imposed cost as a percent of all liabilities, ΔM is the increase in the risk premium charged by the market as a percent of uninsured liabilities, σ is the risk of the bank, r_L is the marginal revenue on loans, $r_{U,\sigma}$ is the all-in marginal cost of uninsured liabilities, $r_{I,\sigma}$ is the all-in marginal cost of insured deposits.

A bank chooses initial insured deposits and uninsured liabilities of I^* and $U^* = L^* - I^*$ by equating the marginal revenue on loans, r_L, to the marginal costs of loanable funds, $r_{I,\sigma}$ and $r_{U,\sigma}$. Given that loanable funds can be obtained in either the insured deposit market or in the market for uninsured liabilities, the marginal cost of loanable funds is simply the lower envelope of r_I and r_U. Subsequently, new information regarding the bank's assets in place reveals that bank risk has increased from σ_L to σ_H. The increase in risk leads to an increase in regulatory costs (ΔR) imposed on all liabilities, insured and uninsured. In addition, the cost of uninsured claims will increase in accordance with the change in the risk premium charged by the market for uninsured claims (ΔM). Thus the increase in the cost of uninsured claims($\Delta R + \Delta M$) is greater than the increase in cost of insured deposits (ΔR). Consequently, the bank increases its insured deposits from I^* to $I^* + \Delta I$ and decreases it total liabilities from L^* to $L^* + \Delta I + \Delta U$. By increasing insured deposits and decreasing total liabilities, the bank scales back on its use of the now relatively more expensive uninsured claims.

imperfect supply of insured deposits. As discussed by Flannery (1982), this is consistent with the combination of a limit on the amount of insured deposits per depositor and a finite number of potential depositors, or alternatively, higher search costs for insured deposits outside the bank's local market. The bank also faces a flat marginal cost curve for uninsured liabilities, r_{U,σ_L}, consistent with a more competitive capital market than the insured deposit market. Given that the bank will choose the source of loanable funds with the lowest marginal cost, the bank's marginal cost of loanable funds is the lower envelope of the insured deposit and uninsured liability curves. Finally the bank faces a downward sloping marginal revenue curve for loans, r_L. As discussed by Klein (1971), this is consistent with banks' finite opportunities to lend due to geographic and regulatory restrictions or limited expertise with certain types of loans.

In Fig. 1, a bank raises loanable funds equal to L^*, consisting of I^* dollars of insured deposits and $U^* = L^* - I^*$ of uninsured liabilities. In choosing L^*, I^*, and U^*, we assume a bank also chooses its initial risk level, σ_L. Subsequently, new information regarding the bank's assets in place reveals that bank risk has increased from σ_L to σ_H. This increase in risk leads to an increase in regulator imposed costs which we distribute evenly on a per dollar basis across all liabilities in the amount of ΔR. In addition, uninsured liabilities also bear an increase in the risk premium charged by the market, ΔM. The effect of the increased risk premium is to drive up the relative cost to the bank of using uninsured claims. These new marginal cost curves, r_{I,σ_H} and r_{U,σ_H}, lead the bank to increase insured deposits from I^* to $I^* + \Delta I$ and to decrease total liabilities from L^* to $L^* + \Delta I + \Delta U$.

Fig. 1 suggests two potential bank manager responses to reduce the cost associated with the increase in risk. Bank managers will increase their use of insured deposits in order to reduce the bank's reliance on the now relatively more costly uninsured liabilities. In addition, they will draw down liabilities until the marginal cost of liabilities equals the marginal revenue on loans. Combined, these two responses lead insured deposits to become a larger fraction of the bank's total liabilities. Empirical tests reveal that downgraded banks do indeed reduce liabilities and increase insured deposit use, with the latter occurring both on an absolute basis and as a percentage of total liabilities.

The regulatory environment assumed in our setup forces the cost of market-priced liabilities to be more sensitive to risk increases than the cost of insured deposits. This result derives from our assumption that regulatory costs are invariant to insured deposit use. While this assumption is generally consistent with risk-based capital standards and deposit insurance premia, there may exist regulatory costs more directly linked to insured deposit use.[5] The existence of such costs would cause banks to use more uninsured liabilities. Thus, results consistent with the graph would indicate that markets and bank managers perceive those regulatory costs tied directly to insured deposit use to be less sensitive to risk increases than the costs associated with market discipline. To capture this more general framework, and facilitate exposition, we refer to the costs associated with market-priced liabilities as market discipline, and the costs associated with insured deposit use as regulatory discipline.

Our analysis draws upon two distinct literatures; market discipline in banking and the effect of ratings changes. The extant literature on market discipline in banking indicates that premia on uninsured bank liabilities are correlated with

[5] We are unaware of any such costs tied directly to insured deposit use.

proxies for bank risk; a necessary condition for market discipline to be effective.[6] Prior studies of rating agency actions document two important consistencies. One, rating changes reveal new information to the capital markets. Holthausen and Leftwich (1986) document significantly negative abnormal returns to the announcement of rating agency downgrades while Schweitzer et al. (1992) replicate this result for a sample of banks. Two, Crabbe and Post (1994) find that firms alter their financing mix in response to a rating change.

3. Data

Our initial sample consists of announcements of credit rating changes for bank holding companies (BHCs) for the period January 1990 through December 1995. We gather rating announcements from quarterly issues of *Moody's Credit Opinion/Financial Institutions* (Moody's 1990–1995 quarterly). This source identifies the old and new debt rating and the date on which the rating action occurred. We retain bank holding companies which have stock returns on either the Center for Research in Securities Prices (CRSP) or National Association of Securities Dealers Automated Quote System (NASDAQ) tapes, giving us a sample of 233 ratings change announcements. There are 125 downgrades and 108 upgrades.[7]

3.1. Sample of downgraded banks

For each of the downgrade announcements, we verify the announcement date using the Dow Jones News Retrieval System (DJNRS). For 58 of the 125 downgrades, DJNRS carried the story either after 4:00 PM or the next day. We restate the announcement date for these 58 observations as the day after the Moody's announcement.

Our empirical tests relate the equity response to downgrade announcements to the financial characteristics of the bank holding company. For holding companies which are completing a merger during the quarter of the downgrade announcement, it is unclear whether the market is relying on the financial characteristics of the acquirer or the merged entity. After eliminating nine downgrades of holding companies which completed mergers during the quarter of the downgrade, we are left with 116 downgrades.

[6] See footnote 2.

[7] We analyze upgrades for additional evidence of bank responses to changes in risk (see Section 5.2).

3.2. Stock returns

Stock return data is obtained from the CRSP and NASDAQ tapes. For each ratings announcement, we collect stock returns in the window from 200 days before the announcement through 5 days after the announcement (-200, $+5$). To calculate the abnormal returns or prediction errors (PEs) over the announcement period, we estimate a market model for each firm over the period (-200, -20). We then use the market model parameter estimates and the CRSP value-weighted return index to calculate a risk-adjusted expected return for each firm. The prediction error is the difference between the expected return and the actual return:

$$\mathrm{PE}_{jt} = R_{jt} - (a_j + b_j * R_{mt}), \tag{1}$$

where R_{jt} is the equity return for firm j over period t, a_j is the OLS estimate for the alpha of firm j, b_j is the OLS estimate for the beta of firm j, R_{mt} is the CRSP value-weighted index return over period t.

We standardize the prediction errors using Patell's (1976) methodology to generate Standardized Prediction Errors (SPE), where

$$\mathrm{SPE}_{jt} = \mathrm{PE}_{jt}/S_{jt}, \tag{2}$$

$$S_{jt} = \left(V_j^2 \left[1 + \frac{1}{D} + \frac{(R_{mt} - \bar{R}_m)^2}{\sum_{i=1}^{D} (R_{mi} - \bar{R}_m)^2} \right] \right)^{1/2}, \tag{3}$$

and V_j^2 is the residual variance from the market model, and D is the number of days, 181, used to estimate the market model.

3.3. Bank operating characteristics

We also attempt to detect changes in banks' funding mix around Moody's long term credit rating changes. We obtain balance sheet data for individual banks from the Call Report tapes and for bank holding companies from the Federal Reserve Y-9 data tapes. We use the Y-9 data to calculate the leverage ratio and the Call Report data to calculate measures of the reliance on insured deposits.[8] The Call Report data includes information that renders a better estimate of insured deposits (see definition of insured deposits below). To construct holding company level deposit data using the Call Reports, we aggregate the data for all individual banks owned by the same holding company. Below, we list the data items collected from our two data sources. Each

[8] The use of non-consolidated deposit data could cause errors in our deposit variables. However, our results are robust to the use of Y-9 data based measures of insured deposit use (see the Appendix A).

variable is measured at the end of each of the quarters -2 to $+4$ where quarter 0 is the quarter ending prior to the rating action:

Leverage:	Total Liabilities/Total Assets (calculated using Y-9 data).
Total Deposits:	All deposits including foreign deposits. Foreign deposits are all uninsured.
Insured Deposits:	Estimated as total deposits less deposit amounts of over \$100,000 and foreign deposits. Finally, *fully insured* brokered deposit amounts of more than \$100,000 are added back (because they are necessarily eliminated by taking out amounts over \$100,000). These large insured brokered deposit accounts are not reported separately on the Y-9 holding company reports.
Uninsured Deposits:	Estimated as Total Deposits less Insured Deposits.
Foreign Deposits:	Estimated as Total Deposits less Total Domestic Deposits.
Commercial Paper:	Listed on the Y-9 data tapes.

We are unable to find complete call report or Y-9 data for seven of our observations. The final sample of downgrades for which we have all stock return data and bank operating characteristics and for which there was no simultaneous merger consists of 109 observations. We use all 109 downgrade observations in our examination of changes in bank liability mix in response to risk changes (Section 5).

When measuring bank equity responses to risk changes, we intend to measure equity responses to similar changes in firm risk. We therefore eliminate 27 observations with significant firm specific confounding events in the $(-3, 1)$ trading day window around the downgrade. We also eliminate 23 observations with a previous mention by either Moody's, Standard & Poor's or Fitch of a rating action; either a downgrade or placement under review. Our clean sample for the equity response analysis performed in Section 4 consists of 59 observations.

Consistent with the recessionary period of 1990–91, our downgrades are concentrated at the beginning of our sample period. Of our 59 clean observations, 41 occur in 1990, 17 in 1991 and one in the first quarter of 1992. We find 10 downgrades between the second quarter of 1992 and the fourth-quarter of 1995, but each of these contains confounding events.

4. Bank equity responses to downgrade announcements

Table 1 presents descriptive statistics for the 59 downgraded banks' balance sheet ratios and market data (beta, stock price, three-day prediction error (PE),

Table 1
Descriptive statistics of clean sample of banks with debt downgraded by Moody's

The sample includes announcements with no confounding events on days [− 3, 1], and no previous mention of the downgrade from either Moody's, Standard and Poor's or other rating agencies. All balance sheet data (except data used to calculate leverage) are the aggregates of all affiliate banks of the BHC, measured at the end of the quarter prior to the downgrade announcement, in millions of dollars. Leverage (total liabilities/total assets) is calculated using data on each BHC. Beta is the estimated slope from the market model regression. PE[− 2, 0] is the cumulative prediction error calculated over the 3 day window from day − 2 through day 0, the announcement date of Moody's downgrade. SPE[− 2, 0] is the standardized estimate of the 3 day prediction error. $SPE_{jt} = PE_{jt}/S_{jt}$, where $S_{jt} = \left(V_j^2 \left[1 + \frac{1}{D} + \frac{(R_{mt} - \bar{R}_m)^2}{\sum_{i=1}^{D} (R_{mi} - \bar{R}_m)^2} \right] \right)^{1/2}$, V_j^2 is the residual variance from the market model, and D is the number of days, 181, used to estimate the market model. Change in rating value is equal to the numerical value for the new rating minus the numerical value for the old rating. Bond rating numerical conversions are provided in Table 2. Higher numbers refer to riskier ratings

	Mean	Median	Min.	Max	N
Insured deposits/total liabilities	64.9%	67.5%	25.3%	88.1%	59
Uninsured deposits/total liabilities	11.7%	11.2%	4.6%	22.1%	59
Total liabilities/total assets (leverage)	94.1%	94.1%	91.8%	98.3%	59
Beta	1.30	1.23	− 0.08	3.65	59
$ Stock price (day − 2)	16.388	15.625	1.375	39.250	59
PE [− 2, 0]	− 1.14%	− 1.78%	− 14.62%	19.35%	59
SPE [− 2, 0]	− 0.34	− 0.43	− 5.18	3.30	59
Change in rating	1.5	1	1	3	59
Old rating	10(Baa2)	10(Baa2)	5(Aa3)	17(B3)	59

and standardized prediction error (SPE)).[9] We report the mean, median, minimum, maximum and number of observations for each variable in the sample. Consistent with Holthausen and Leftwich (1986) and Nayar and Rozeff (1994) the average three-day PE to the downgrade announcement (− 1.14%), is significantly negative at the 5% level Finally, Table 1 presents summary information on the previous Moody's rating and the magnitude of the rating change. We provide bond rating numerical conversions in Table 2.

[9] We use a three day window, consistent with Nayar and Rozeff (1994), to calculate the equity response to a downgrade because of significant observed price effects on trading days − 2 and 0. The day − 2 effect is consistent with information leakage regarding the upcoming downgrade announcement. Our results are robust to the use of a one-day window (day 0). While we report univariate results using both one-day and three-day windows in our table, we will henceforth discuss only the three-day window results.

Table 2
Bond rating numerical conversions

Each bond rating is assigned a numerical equivalent. This numerical ranking facilitates empirical tests

Moody's rating		Numerical value
Aaa		2
Aa1		3
Aa2		4
Aa3		5
A1		6
A2		7
A3		8
Baa1		9
Baa2		10
Baa3		11
- - - - -		- - - - -
Ba1	JUNK ↓	12
Ba2		13
Ba3		14
B1		15
B2		16
B3		17
Caa1		18
Caa2		19
Caa3		20
Ca		21
C		22
D		23

4.1. Univariate results

Table 3 presents univariate evidence on equity price reactions to bank downgrades. The results indicate that the average clean sample bank experiences a significant decline in shareholder value at the announcement of a Moody's long term credit rating downgrade. The mean three-day prediction error (days $(-2, 0)$) of -1.14% has a corresponding mean standardized prediction error of -0.342 which is significantly different from zero ($Z = -2.63$). The median loss in shareholder value over this window is 1.78%, different from zero with 94% confidence based on a sign test.

Table 3 also examines stock price reactions to downgrade announcements of banks with high versus low ratios of insured deposits to total liabilities (at the end of the quarter prior to the downgrade). Downgraded banks with HIGH percentages of total liabilities in insured deposits (ratio of insured deposits to

Table 3
Univariate statistics for clean sample of downgrade announcements

This table presents cross-sectional mean and median prediction errors to downgrade announcements. Observations are drawn from Moody's downgrades of bank debt claims during the period January 1990 through December 1995. The final sample excludes downgrades of companies that do not have sufficient stock return data, that completed mergers during the quarter of the downgrade, that experienced other firm-specific events during the [− 3, 1] window, or that had a previous mention by either Moody's, Standard & Poor's, or Fitch of a rating action. Z-statistics test whether the average standardized prediction errors for HIGH versus LOW insured deposit ratio banks differ from each other. Significance levels for differences in medians are based on generalized sign tests. HIGH insured deposit ratio banks are those with insured deposits/total liabilities exceeding the median ratio of insured deposits/total liabilities. The one-day window is day 0, the restated announcement date. The three-day window is [− 2, 0].

		Level of insured deposits			Significance test for difference between HIGH and LOW
		All Banks ($N = 59$)	HIGH ($N = 30$)	LOW ($N = 29$)	
1-day window					
Mean	PE	− 0.579%	0.223%	− 1.409%	$Z^a = 2.92$***
	(SPE)	(− 0.277)***	(0.096)	(− 0.663)***	
Median	PE	− 0.327%	0.175%	− 0.685%	$\chi^2 = 2.988$*
	(SPE)	(− 0.177)	(0.064)	(− 0.335)**	
3-day window					
Mean	PE	− 1.142%	0.253%	− 2.585%	$Z^a = 3.00$***
	(SPE)	(− 0.342)***	(0.042)	(− 0.739)***	
Median	PE	− 1.781%	0.175%	− 0.685%	$\chi^2 = 3.093$*
	(SPE)	(− 0.431)***	(− 0.253)	(− 0.671)*	

*,**,*** Significantly different from 0 at the 10%, 5% and 1% levels, respectively.
[a] See Travlos (1987) for formula.

total liabilities exceeds the median ratio for the clean sample), are associated with insignificant abnormal returns at the announcement of the downgrade. The three-day window mean and median standardized prediction errors do not differ from zero. By contrast, LOW insured deposit ratio banks exhibit significantly negative abnormal returns to the announcement of a downgrade. The z-statistics for three-day mean and median standardized prediction errors are − 3.98 and − 1.67.

Importantly, the mean and median standardized prediction errors for the HIGH and LOW insured deposit ratio banks are significantly different. The z-statistic of − 3.00 [see Travlos (1987) for the appropriate formula] for the three-day window test indicates that shareholders of banks with LOW insured deposit ratios experience more negative mean abnormal returns to the announcement of downgrades than shareholders of HIGH insured deposit ratio banks. The χ^2 statistic from a Wilcoxon test of differential median three-day standardized prediction errors across groups is significant at the 90% level ($\chi^2 = 3.09$). Moreover, if we partition our sample of banks into three groups with 'low', 'medium', and 'high' ratios of insured deposits to total liabilities, a Kruskal–Wallis test indicates that median abnormal returns are significantly different between the groups ($\chi^2 = 8.1$).[10] Overall, our results are consistent with the hypothesis that the all-in cost of insured claims is expected to reprice less severely than uninsured claims at the announcement of a downgrade.

4.2. Multivariate results

The univariate analysis in Table 3 implicitly assumes that only the bank's classification based on insured deposit ratios affects its stock price reaction to a downgrade. However, Holthausen and Leftwich (1986), and Schweitzer et al. (1992) have hypothesized that the severity of the downgrade is an important determinant of the price reaction, while Nayar and Rozeff (1994) show that firm leverage affects the estimated abnormal equity returns to commercial paper downgrades. We control for these factors as well as a measure of the bank's initial risk in our multivariate analysis.

4.2.1. Anticipation of downgrade

In addition to controlling for observable factors that may affect the market's reaction to a downgrade, we control for the possibility that the market anticipates downgrade announcements by some firms and thus reacts less strongly to the news. We attempt to control for market anticipation of a forthcoming downgrade announcement in two ways. First, we include an additional control variable in our multivariate analysis, RUNUP, equal to the cumulative abnormal return over the window $[-10, -3]$.[11] To the extent that market anticipation of a downgrade announcement is priced solely in this window, this variable suffices to control for anticipation. However, we cannot be sure that anticipation is entirely priced in the window $[-10, -3]$.

We further attempt to control for anticipation of a downgrade by estimating the likelihood of downgrade for each clean downgrade announcement. The

[10] The median three-day standardized prediction errors are -1.02, -0.29, and 0.05 (low, medium, and high respectively). This apparently monotonic relationship in the median stock price reactions to downgrades as a function of insured deposit use suggests that the results are not driven by outliers and supports the use of a continuous insured deposit ratio variable in the multivariate tests.

[11] Billett et al. (1995) use a similar measure of anticipation prior to bank loan announcements.

forecasted likelihood is the in sample forecast generated using parameter estimates from a logistic regression explaining whether a bank experiences a downgrade during a particular quarter (down $=1$) or not (down $=0$), as a function of a set of control variables described below. Our anticipation control variable, SURPRISE, is equal to one minus the estimated probability of a downgrade.

The sample for the logistic regression is the set of *all* banks rated by Moody's at some time during our sample period (1/90–12/95). The logistic regression includes the following variables: the cumulative net of market return on the bank's stock; the standard deviation of the bank's equity returns; the standard deviation of S&P 500 returns; total liabilities/total assets (leverage); insured deposits/total liabilities; net charge-offs as a proportion of total loans; change in non-performing loans; change in insured deposits/total liabilities; change in tier 1 capital/total liabilities;[12] and change in equity volatility. The cumulative return and standard deviations of returns are measured over the quarter preceding the downgrade/non-downgrade. Given the step function nature of ratings changes, credit quality must decline a certain amount before passing a threshold to invoke a rating change. Cumulative net of market returns captures smaller declines in credit quality that may be insufficient to invoke a rating downgrade. The three levels ratios are measured at the end of the quarter preceding the quarter of interest. The three changes ratios represent changes over the quarter preceding the quarter of interest. Finally, the change in equity volatility is calculated as

$$\%\Delta\sigma = \frac{\sigma_0 - \sigma_{-1}}{\sigma_{-1}}, \tag{4}$$

where subscript zero refers to the quarter prior to the downgrade quarter, subscript -1 refers to the quarter preceding quarter 0, and sigma is the standard deviation of stock returns over the indicated quarter.

The results from the logistic regression (not shown) indicate that factors such as larger capital increases, higher net charge-offs, lower leverage, and decreases in non-performing loans are all associated with a lower likelihood of downgrade. The negative relationship between net charge-offs and probability of downgrade seems to be driven by multicollinearity. A univariate logistic regression of downgrade incidence ($0=$ no, $1=$ yes) on net charge-offs yields a significantly positive coefficient (p-value < 0.01).[13] Results from the multivariate

[12] Tier 1 capital consists of common equity, qualified perpetual preferred stock, and minority interests in equity accounts of consolidated subsidiaries less goodwill.

[13] If we remove net charge-offs from the multivariate logistic regression, our logit results are similar in terms of signs and significance levels.

logistic regression also show a significantly negative coefficient on the net of market return over the quarter preceding the downgrade/no-downgrade. Perceptions of declining financial condition, as measured by more negative cumulative market adjusted returns, are associated with a greater likelihood of downgrade in the following quarter. Finally, we observe a significantly positive coefficient on the percentage change in equity volatility. Higher stock price volatility, a proxy for increasing risk, is associated with a greater likelihood of downgrade in the following quarter. These results are consistent with our interpretation of downgrades as indicators of increased risk to debtholders of banks.

4.2.2. Regression results

Table 4 presents ordinary least squares regressions of the three-day abnormal return to Moody's downgrade announcements.[14] Model I regresses abnormal returns on leverage, change in rating, SURPRISE, RUNUP, and a measure of the bank's previous rating (bond rating conversions are presented in Table 2). None of these variables explains a significant amount of the cross-sectional variation in abnormal returns. The overall explanatory power of the regression is low, with an F-statistic $= 1.091$ (p-value $= 0.376$).

Model II differs from Model I only by inclusion of the ratio of insured deposits to total liabilities. The coefficient on this variable (0.134) is significantly positive ($t = 2.69$), indicating that banks with relatively more insured deposits experience less negative price reactions to downgrade announcements, ceteris paribus. This finding is consistent with the all-in cost of insured deposits being less sensitive to increases in credit risk than the cost of uninsured liabilities.

Economically, the coefficients from Model II indicate that a 10% increase in the ratio of insured deposits to total liabilities is associated with a 1.34% increase in the estimated abnormal return to a downgrade announcement. Given that the difference between the average insured deposit ratios for HIGH and LOW ratio banks is approximately 21.1% and statistically significant, high insured deposit ratio banks would on average be associated with a 2.83% higher abnormal return at the announcement of a downgrade. The adjusted R^2 of 11.76% is higher than Holthausen and Leftwich (1986) find for a sample of all industrial firms and higher than Schweitzer et al. (1992) find for banking firms when not taking into account insured deposit use.

Models III and IV present variations of Model II. In Model III, we replace the ratio of insured deposits to total liabilities with the natural log of this ratio. The

[14] We report t-statistics calculated using White's heteroskedasticity consistent standard errors. There is weak evidence of heteroskedasticity in our estimates. Both the Breusch/Pagan statistic and White's statistic based on the residuals from our regression in Table 4, Model II, are significant with 90% confidence. Ordinary least squares results without 'White' corrected standard errors (available upon request) are qualitatively identical.

Table 4
Ordinary least squares regressions of abnormal return to downgrade announcements on proxies for changes in risk and exposure to market and regulatory discipline

This table presents ordinary least squares regressions of three-day abnormal returns on proxies for risk, the change in risk, and the bank's relative exposure to market and regulatory discipline. The abnormal returns are prediction errors from a standard market model. The sample is the set of downgrade announcements between January 1990 and December 1995 with no confounding news stories in the transaction day window [− 3, 1] and no previous mention during the calendar month preceding the downgrade. All balance sheet variables are aggregates of all affiliate banks of the bank holding company (BHC) at the end of the quarter prior to the downgrade (except Leverage which is calculated using data for the BHC). Change in rating equals the difference between the new Moody's bank debt rating (integer number; see Table 2 for mapping) and the previous debt rating. Leverage equals total liabilities divided by total assets. SURPRISE = (1 − (within sample fitted probability of downgrade based on logit estimates described in Section 4.2.1)). RUNUP = cumulative abnormal return over the window [− 10, − 3]. T-statistics based on White's heteroskedasticity consistent standard errors are in parentheses

	Model			
	I	II	III	IV
Insured deposits/total liabilities	—	0.134***	—	0.122**
		(2.69)		(2.04)
ln (insured deposits/total liabilities	—	—	0.064**	—
			(2.42)	
Total deposits/total liabilities	—	—	—	0.044
				(0.450)
Leverage	− 0.004	0.924	0.750	0.850
	(− 0.005)	(0.941)	(0.755)	(0.896)
Change in rating	− 0.009	− 0.011	− 0.010	− 0.012
	(− 0.809)	(− 1.11)	(− 1.01)	(− 1.27)
Previous rating	− 0.001	− 0.003	− 0.003	− 0.003
	(− 0.301)	(− 1.36)	(− 1.17)	(− 1.35)
SURPRISE	0.26	0.036	0.033.	0.032
	(0.501)	(0.740)	(0.655)	(0.661)
RUNUP	0.110	0.104	0.106	0.010
	(1.41)	(1.39)	(1.41)	(1.33)
Constant	− 0.009	− 0.953	− 0.672	− 0.903
	(− 0.010)	(− 0.998)	(− 0.713)	(− 0.970)
N	59	59	59	59
Adj. R^2	0.0078	0.1176	0.0886	0.1022
F-statistic	1.091	2.288	1.940	1.943
p-value (F)	0.3764	0.0492	0.0917	0.0817

*,**,*** Significant at 10%,5%, and 1% levels, respectively.

estimated coefficient on the logged insured deposit ratio of 0.064 is significantly greater than zero, with a t-statistic of 2.42. Model IV includes an additional explanatory variable, the ratio of total deposits to total liabilities. The coefficient on insured deposits to total liabilities (0.122, t = 2.04) can be interpreted as the differential effect between insured deposit and uninsured deposit use on equity's announcement return. The results indicate that abnormal returns are related specifically to insured deposit usage rather than total deposit usage.

We perform extensive sensitivity analyses to evaluate whether the primary result, shown in Table 4, depends on the particular specifications shown. These robustness checks are detailed in the appendix, but in general the significance of the insured deposits to total liabilities ratio is robust to a wide range of sample and specification changes. The extent to which a bank faces regulatory versus market discipline seems to be an important determinant of the costs to shareholders of excessive risk taking.

5. Changes in bank liability structure

One potential drawback of the above research design is that the period over which the revaluation of equity is measured may occur after the market has priced the anticipated cost of regulatory action. For example, if regulatory action is taken against the bank or is anticipated to occur prior to the Moody's downgrade announcement and such action is detected by the market, then the equity reaction in response to the downgrade may not include the expected cost of regulatory action. Berger and Davies (1994) find that equity responds to changes in bank CAMEL ratings even though these ratings are not public information. Also, some regulatory actions may not be costly to shareholders, and systematic differences may exist in the information content of downgrades for banks that rely more versus less heavily on insured deposits. We therefore employ an alternative approach to assess the differential costs of insured and uninsured deposits.

The second test for a difference between the costs of exposure to regulatory and market discipline examines the change in the structure of a bank's liabilities surrounding the downgrade. If the cost of one source of liabilities is less elastic with respect to revealed risk changes than another, and if transactions costs associated with changing capital structure are low, the bank will presumably adjust its liability structure accordingly. We expect to observe an increased use of insured deposits by downgraded banks, consistent with bank managers perceiving and actively exploiting a smaller increase in the cost of insured deposits compared to uninsured liabilities.

5.1. Changes in deposit composition by downgraded banks

For this analysis, we employ the 109 downgrade announcements originally identified in Moody's Credit Opinions/Financial Institutions, for which the bank is not completing a merger in the quarter of the downgrade. We split the total deposits of the banks into insured and uninsured deposits and identify the

Table 5
Changes in bank holding company liability mix around rating downgrades

The sample consists of all rating actions for which no merger was completed during the quarter of the rating action and for which call report data is available for deposits (or for which Y-9 data is available for the change in Commercial Paper tests). Panel A reports the mean change in component bank liabilities as a percentage of total liabilities. For each observation, the change equals the ratio at the end of the quarter of the rating action minus the ratio at the beginning of the quarter. Panel B reports percentage changes calculated as the difference between ending quarter and beginning quarter values divided by beginning quarter value. Total assets and total liabilities are obtained from the Y-9 report. Percentage changes for commercial paper are not calculated when the beginning period value is zero, deleting 31 downgrades from the analysis. *T*-statistics are in parentheses.

Panel A: *Changes in ratio of component liabilities to total liabilities*

Variable	Mean	% Positive	*N*
Change in (insured deposits/total liabilities)	2.07%*** (7.06)	74.1%[c]	109
Change in (uninsured deposits/total liabilities)	− 0.92%*** (− 4.56)	24.8%[c]	109
Change in (domestic deposits/total liabilities)	1.50%*** (4.93)	64.7%[c]	109
Change in (total deposits/total liabilities)	1.14%*** (3.87)	63.8%[c]	109
Change in (commercial paper/total liabilities)	− 0.40%*** (− 3.35)	13.8%[c]	78

Panel B: *Absolute changes in component liabilities*

Variable	Mean change	% Positive	*N*
Total assets	− 1.62%*** (− 2.71)	34.5%[b]	109
Total liabilities	− 1.59%** (− 2.57)	37.1%[b]	109
Insured deposits	1.42%* (1.93)	61.2%[b]	109
Uninsured deposits	− 6.56%*** (4.95)	25.8%[c]	109
Commercial paper	− 27.94%*** (− 6.16)	14.7%[c]	78

*,**,*** Significant at 10%, 5% and 1% levels, respectively.
[a,b,c] Significantly different from 50% at the 10%, 5% and 1% levels, respectively.

amount of commercial paper of the bank. For each component liability, we calculate the ratio to total liabilities. Mean changes in this ratio from the beginning of the quarter in which the rating action occurs to the end of the quarter are shown in Panel A of Table 5.

For this sample of downgrades, all changes in component liability ratios are significant at the 1% level. Consistent with the theory that banks respond to differential changes in the cost of exposure to regulatory versus market discipline by altering their reliance on insured deposits, results show a 2.07% increase in the ratio of insured deposits to total liabilities during the quarter of the downgrade. This increase is accompanied by a corresponding 0.92% decrease in the use of uninsured deposits relative to total liabilities. The relative use of total deposits increases significantly, as does the relative use of domestic deposits. Finally, the change in the commercial paper ratio is -0.40%, further indicating a reduction in the reliance on uninsured liabilities in periods of increasing default risk. All of our downgrade results using the mean are supported using the median by sign tests.

The increase in the use of insured deposits by downgraded banks documented in Panel A is a relative increase. Bank managers could effect a relative increase in insured deposits over a quarter by maintaining the dollar amount of insured deposits while decreasing total assets (and total liabilities). A more active insured deposit management strategy would entail increasing the dollar amount of insured deposits. Panel B of Table 5 measures absolute changes in component liabilities.

Both total assets and total liabilities are shown to decline significantly in the quarter of a downgrade. However, we find that insured deposits increase by 1.42% even in the presence of shrinking assets and total liabilities. By contrast, uninsured deposits and commercial paper use decline by 6.56% and 27.9% respectively during downgrade periods. The commercial paper result parallels the findings of Crabbe and Post (1994) who document significant decreases in outstanding commercial paper in the quarter after a short term debt downgrade. Our findings are consistent with the theory that bank managers perceive a significant difference between the costs of exposure to market versus regulatory discipline; banks actively seek to increase their insured deposit base and decrease their market-priced uninsured liability base as they become more risky. Our mean change results are supported in the median by sign tests. These conclusions are unchanged if we restrict our analysis to the sample of 59 downgrades that experience no other firm specific events during the $[-3, +1]$ window and had no previous mention of a downgrade.

5.2. Longer run changes in deposits as a percentage of total liabilities

While rating changes are discrete in nature, the changes in default risk for which they proxy are often continuous. Considerations such as deterioration in asset quality, suspect liquidity levels, and low capital levels are examples of gradual changes in bank risk that at some point trigger a rating change. In contrast, merger activity and unanticipated earnings or dividend announcements are discrete events that may precipitate rating activity. Because changes in bank risk may be more gradual than the rating action itself, we may find that banks begin to change their reliance on insured deposits in the months preceding ratings changes. Banks may also continue to alter their liability mix in the months after rating changes as default risk continues to increase or because instantaneous responses to discrete risk changes are difficult if not impossible to effect.

To examine bank behavior in the quarters before and after the downgrade, we return to our measurement of insured deposits relative to total liabilities. We focus on changes in insured deposit use because longer run changes in uninsured deposit use are summarily insignificant. The analysis is complicated by the fact that some of our observations are successive downgrades of the same bank. This will potentially confound our ability to detect insured deposit composition changes in quarters leading up to and following a downgrade. For example, if a bank is downgraded in quarters 1 and 3, we cannot determine which fraction of changes in deposit composition in quarter 2 are due to the first downgrade or the second downgrade. We follow two steps to address this problem.

First, Panel A of Table 6 examines insured deposit use changes over the two quarters preceding the downgrade quarter, using subsets of downgraded banks. The table shows both the mean and median change in insured deposit use over the quarter preceding the downgrade, Q(− 1), by banks without downgrades in the four quarters preceding Q(0). Similarly, we estimate changes in insured deposit use over Q(− 2) for the sample of banks with no rating downgrades in the five quarters preceding Q(0). This approach ensures that we do not document significant changes in insured deposit use preceding a downgrade that are actually due to an earlier downgrade. Quarters Q(− 2) and Q(− 1) are characterized by insignificant changes in insured deposit funding. It is therefore unlikely that there will be significant changes in quarters prior to Q(− 2).

The second step is to examine over how many subsequent quarters a downgrade might influence bank deposit composition. For this analysis, we again construct subsamples of downgraded banks. Specifically, we analyze the mean and median change in insured deposit use over the first quarter following the downgrade quarter, Q(+ 1), for the set of banks with no rating action in Q(+ 1). Similarly, the sample analyzed for changes in insured deposit use during Q(+ 2) is the set of banks with no rating downgrade in either Q(+ 1) or Q(+ 2). The subsample of banks analyzed in Q(+ 3) had no rating downgrades during quarters + 1 through + 3. The results presented in Panel B of Table 6 indicate significant increases in both the mean and median use of insured deposits in each of the three quarters following a downgrade.

Results to this point indicate that bank managers alter deposit composition in the quarter of the downgrade and potentially up to three quarters after the downgrade. One potential confounding factor is that periods in which banks are downgraded may be marked by industry-wide changes in deposit composition. In this case, detected changes in deposit composition for downgraded banks may be no different than those for banks that are not downgraded. To address this potential problem, we restate the relative changes in insured deposit use in each quarter net of the relative changes for the average large bank in that quarter. The relative change is measured against a sample of all U.S. banks with at least $500 million in assets. Both the set of downgraded banks and unrated banks are included in the average bank calculation. Given the general decline in overall creditworthiness in the banking industry during our sample period, net changes should be biased towards zero.

Panel C of Table 6 shows the industry adjusted results. The net changes tell a somewhat different story. It appears that significant changes in average insured deposit use are confined to the quarter of and the quarter following the downgrade (Q(0) & Q(+ 1)). These results are supported in tests of the median. The percent of observations with positive industry adjusted changes in insured deposit use during quarters Q(0) and Q(+ 1), exceeds 50%. Overall, the findings indicate that bank managers increase their reliance on insured deposits more than the industry in the quarter of and following a Moody's downgrade. This finding is consistent with the costs of regulatory discipline becoming relatively less expensive than the costs of market discipline in times of increasing bank risk.

As previously mentioned, this sample of downgrades is concentrated in the period 1990–91. In December of 1991, Congress passed the Federal Deposit Insurance Corporation Improvement Act (FDICIA). This act was primarily designed to recapitalize the insurance fund of the FDIC and to increase regulatory discipline. Risk-taking deterrence provisions included higher capital ratio requirements, prompt corrective regulatory actions, and risk-based deposit insurance premia. A logical concern about these results is whether they are applicable to the post-FDICIA regime. The lack of downgrades in the 1992–95 period makes this a difficult issue to address. For the ten downgrades during the post-FDICIA period, changes in insured deposit funding in quarters Q(0) through Q(+ 2) are positive and of similar magnitudes to the full-sample changes. However, these changes are not significant at conventional levels, presumably due to the small sample size.[15]

To determine whether bank managers still respond in the post-FDICIA era as if the cost of market discipline is more sensitive to risk than the cost of regulatory discipline, we examine changes in banks' reliance on insured deposits around Moody's *upgrades*. Between 1990 and 1995 there were 108 upgrades, 94 of which occur in the post-FDICIA time period. We perform the same analysis

[15] For post-FDICIA downgrades, the raw changes (T-statistics) in insured deposits for Q(0), Q(+ 1) and Q(+ 2) are 1.02% (1.81), 0.58% (0.65), and 1.11% (0.69). The changes net of industry average (T-statistics) are 0.71% (1.19), 0.78% (0.88), and 1.36% (0.89).

Table 6

Insured deposit composition changes in quarters around downgrade announcements

This table shows mean and median changes in deposit to total liability ratios for bank holding companies in the quarters around downgrade announcements. Q(0) is the quarter of the downgrade. Q(− 1) is the quarter before the downgrade, Q(− 2) is two quarters before the downgrade. Quarters Q(+ 1), Q(+ 2) and Q(+ 3) represent successive quarters after the downgrade. Panels A and B present deposit composition changes for various subsamples of downgraded banks. The Q(− 2) analysis is based on the sample of downgraded banks without a downgrade in the 5 preceding quarters, and the Q(− 1) analysis is based on the sample of downgraded banks without a downgrade in the 4 quarters preceding Q(0). The sample for Q(+ 1) changes in insured deposit use is the set of downgraded banks without rating downgrades in Q(+ 1), while the sample for Q(+ 2) changes is the set of downgraded banks without a subsequent downgrade in either Q(+ 1) or Q(+ 2), and the sample for Q(+ 3) changes is the set of downgraded banks without a subsequent downgrade in Q(+ 1), Q(+ 2), or Q(+ 3). Deposit composition changes are calculated as the difference between ending quarter and beginning quarter ratios. Panel C presents deposit composition changes net of the industry average in that quarter. Changes net of the average bank are calculated as the raw change minus the average contemporaneous change of all U.S. bank holding companies with more than $500 million in assets. *T*-statistics are in parentheses.

Panel A: *Changes in deposit composition in quarters before downgrades*

	Q(− 2): $N = 59$	Q(− 1): $N = 64$
Change in (insured deposits/total liabilities)	0.50%	0.39%
	(1.59)	(1.33)
%of positive observations	54.54%	59.37%

Panel B: *Changes in deposit composition in quarters after downgrades*

	Q(0): $N = 109$	Q(+ 1): $N = 86$	Q(+ 2): $N = 68$	Q(+ 3): $N = 52$
Change in (insured deposits/Total liabilities	2.07%***	1.71%***	1.30%***	1.28%***
	(7.06)	(4.64)	(3.70)	(3.44)
% of positive observations	78.90%[c]	77.91%[c]	72.06%[c]	71.12%[c]

Panel C: *Net of industry changes in deposit composition in quarters after downgrades*

	Q(0): $N = 109$	Q(+ 1): $N = 86$	Q(+ 2): $N = 68$	Q(+ 3): $N = 52$
Change in (insured deposits/Total liabilities	1.29%***	0.90%***	0.49%***	0.35%***
	(4.59)	(2.43)	(1.39)	(0.96)
% of positive observations	60.55%[b]	60.47%[a]	51.47%	55.77%

*,**,*** Significant at 10%, 5% and 1% levels, respectively.
[a,b,c] Significantly different from 50% at the 10%,5%, and 1% levels, respectively

for the upgrades as we do for the downgrades. One difference between the upgrades and downgrades results is that there is no significant change in insured deposit use in the quarter of the upgrade. However, quarters Q(+ 1) and Q(+ 2) are characterized by significant declines in average insured deposit use, both raw and adjusted for the industry. The insignificance in Q(0) may indicate that the process of drawing down insured deposits cannot be implemented as quickly as increasing insured deposits. It may also be a function of when the changes occur, at the beginning or the end of the quarter. Results are qualitatively unchanged for upgrades occurring after 1991. We therefore conclude that bank managers respond to risk changes by altering deposit composition in both the pre- and post-FDICIA periods. Taken together, the upgrade results and downgrade results are consistent with the theory that the cost of exposure to regulatory discipline is less sensitive to changes in risk than the cost of exposure to market discipline. This result persists across regulatory regimes.

6. Summary and conclusions

Previous studies of bank market discipline have concluded that capital markets demand risk premia on bank liability claims. We hypothesize that the existence of risk premia is not a sufficient condition for markets to effectively discipline bank behavior. In particular, regulatory discipline substitutes for market discipline when banks use insured deposits. If regulatory discipline is less costly to bank shareholders than market discipline then banks can shield themselves from the impact of market discipline through the judicious use of insured deposits.

We examine the relationship between changes in bank credit risk and the use of insured deposits. Using a sample of Moody's credit rating downgrade announcements, we find that abnormal equity returns increase in banks' use of insured deposits. In addition, downgraded banks increase their use of insured deposits over the quarters of and following the downgrade. Symmetrically, banks reduce their use of insured liabilities following upgrades, consistent with the cost of uninsured liabilities falling relative to the cost of insured deposits in response to a decline in risk.

We conclude that both equity markets and bank managers discern a difference between the costs of regulatory discipline and market discipline. This implies that the current regulatory structure may undermine the effectiveness of market discipline in deterring bank risk-taking. Moreover, the effectiveness of market discipline declines as a bank becomes more risky because riskier banks use more insured deposits.

Solutions to this problem must force banks to bear more fully the costs of market discipline. This could be accomplished by constructing regulatory costs tied directly to insured deposit use or by limiting access to insured deposits. For example, regulators could prohibit banks from substituting insured deposits for uninsured liabilities in times of increasing risk, perhaps by enforcing threshold levels of uninsured claims that differ according to bank risk.

Our findings also have implications for the study of other industries where regulator behavior may impact the incentives of firms and managers. Because markets discipline firms through prices and quantities, regulation that undermines this discipline may result in a situation where managers do not respond to these market signals. That banks increase reliance on insured deposits in times of increased risk is consistent with an economically sub-optimal response to the market's signal through production input distortions. This distortion in inputs is similar to the overuse of capital in the production of power by regulated utilities predicted by Averch and Johnson (1962). Regulators in any industry should expect profit maximizing firms to exploit their regulatory environment. More importantly, dynamic regulation should be tempered with the understanding that this exploitation may compromise the success of regulatory policy.

Appendix A.

We conduct numerous robustness checks to determine whether our main abnormal return results depend on the particular sample or specification used. We detail these robustness checks below. The sign and significance at the 5% level or better, except where noted, of the insured deposits to total liabilities ratio (Table 4, Model II) is preserved for the following specification/sample changes:

1. substitution of firm beta, or the variance of prediction errors, or the previous long term debt rating for the JUNK dummy as a proxy for risk;
2. estimation of announcement abnormal returns over the one-day window, two-day window $[-1, 0]$, or four-day window $[-3, 0]$;
3. retention of observations with confounding news on days -3 and $+1$;
4. substitution of insured deposits/total assets for insured deposits/total liabilities;
5. elimination of observations with a stock price on day -2 less than \$5;
6. elimination of the insignificant control variables from the regression;
7. addition of a set of dummy variables identifying each year in the sample;
8. inclusion of a dummy variable equal to one if the lead bank's debt was downgraded and analysis of the sub-sample of downgrades for which the lead bank was downgraded ($N = 42$);
9. elimination of downgrades that occurred after the enactment of the FDIC Improvement Act of 1991;
10. use of lead bank data from the Call Reports to estimate relative use of insured deposits;

11. use of consolidated holding company data from the Y-9 tapes to estimate relative use of insured deposits;
12. inclusion of the standard deviation of prediction errors from the market model estimation period or the standard deviation of returns over the quarter preceding the downgrade to proxy for anticipation and/or control for the call option characteristic effect on equity value associated with volatility changes;
13. inclusion of the natural log of total assets, obtained from Y-9 data, to control for bank size;
14. inclusion of a dummy variable equal to one if the downgraded bank was a money center bank;
15. inclusion of the change in insured and/or uninsured relative deposit use over the quarter preceding the quarter of downgrade, to further control for anticipation;
16. inclusion of a control variable Repeat, equal to one if the observation represents a downgrade of a bank that appeared earlier in our sample, as a dummy variable and/or interacted with the measure of relative use of insured deposits;
17. use of three-day cumulative net of market return, i.e., alpha $= 0$, beta $= 1$, as the dependent variable;
18. inclusion of a dummy variable YR91 equal to one for downgrades in 1991, and interactives of this variable with the relative insured deposit use variable, where YR91 is designed to pick up any differences between downgrades, and their associated price reactions, in 1990 and 1991;
19. use of a portfolio of bank stocks as a proxy for the market portfolio.

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