Do Deposit Insurance Premiums Affect Bank Risk-Taking?

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Abstract

The near collapse of the FDIC deposit insurance fund in the 1980's prompted numerous calls for overhaul of the deposit insurance system. Several changes, such as risk based capital and premiums, have made the system more sensitive to risk-taking but unfortunately many issues remain unsolved. This study examines whether deposit insurance premium increases themselves may have pro-cyclical elements such that bank risk increased when premiums increased. To determine this potential, a simultaneous equation system of bank risk, return and portfolio choice is estimated for portfolios of banks over the period of 1972-1995. Our findings indicate that the overall impact of higher premiums during this period was an increase in bank risk – as measured by the coefficient of variation of bank portfolio returns on assets. Our results also indicate that the implementation of risk-adjusted capital requirements did act to reduce bank risk-taking.

Key words: banking, deposit insurance, simultaneous equations.
JEL classification: G2, C3

Introduction

It has been a quarter of a century since the beginnings of the Federal Savings and Loan Insurance Corporation (FSLIC) crisis. The economic and regulatory crisis of the 1980s resulted in the demise of the FSLIC and put the Federal Deposit Insurance Corporation (FDIC) fund in peril. Between 1980 and 1990, the FSLIC employed several methods of insolvency resolution, which resulted in the number of insured S&L's declining by more than 1,000 during that period. Besides, over 1,600 FDIC insured banks failed between 1980 and 1994.

Explanations for the high levels of bank failures in the 1980s and early 1990s include 1) severe regional and sectoral recessions (Hanc, 1998); 2) rapidly rising interest rates during the late 1970s and early 1980s (Schwartz, 1987); 3) deregulation in the early 1980s (Keeton, 1984); 4) poor bank management (Flood, 1993); 5) the increase in deposit insurance coverage from $40,000 to $100,000 in 1980 (Benston, Eisenbeis, Horvitz, Kane, and Kaufman, 1986 and Kane, 1985); and 6) poor agent behavior of regulators (Kane, 1985 and 1989). Examination of many banks was infrequent in the early and middle 1980s, therefore the consequences of risky behavior and other problems were not always identified on a timely basis.

Most bank failures during this time period were resolved through purchase and assumption or open-bank assistance agreements that protected uninsured depositors and non deposit creditors, which led to the belief that all deposits were 100% insured. This limited the discipline that depositors may have otherwise exerted on the behavior of banks (FDIC, 1998).

The increases in the number of bank failures resulted in solvency problems for the Bank Insurance Fund (BIF) in the early 1990s. The insurance fund as a percentage of deposits from 1985 to1995 is shown in Table 1. Note that the fund was technically insolvent in 1991 and 1992.

During the 1980s and early 1990s, the banking system created liabilities that the deposit insurance funds were unable to handle. To survive the crisis, deposit insurance premiums were increased by almost 600% between 1980 and 1994. The increase in deposit insurance premiums, the implementation of the Basle Accord that mandated risk-based capital standards, the passage of the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 that required the move to risk-based deposit insurance premiums and called for Prompt Corrective Action provisions designed to limit regulatory forbearance by requiring more timely and less discretionary intervention with the objective of reducing bank failure costs, and a much-improved economy re-

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turned the deposit insurance fund to solvency and allowed for the elimination of deposit insurance premiums at the safest banks.

Table 1

FDIC Deposit Insurance Fund as a Percentage of Insured Deposits, 1934-1995

Year	Percent of Insured Deposits
1934-1971 (Average)	1.48
1972-1984 (Average)	1.19
1985	1.19
1986	1.12
1987	1.10
1988	0.80
1989	0.70
1990	0.21
1991	(0.36)
1992	(0.01)
1993	0.69
1994	1.15
1995	1.29

The deposit insurance funds as a percentage of deposits insured at commercial banks for 1934-1995. Source of the data is the FDIC Annual Report, 1995 FDIC Historical Statistics on Banking.

The FDIC is currently mandated to maintain the BIF at 1.25 cents per dollar of insured deposits. The fund was below this level from 1972 to 1993. By 1995, the BIF was at 1.29 cents per dollar of insured deposits because of the higher premiums paid by banks, the banking industry's health, the fund's low projected losses, and the economy's strength. Because the fund had reached its goal, the FDIC reduced deposit insurance premiums to the regulatory minimum of $2,000 for all banks in the top risk-adjusted premium class. The Deposit Insurance Funds Act of 1996 acts to prohibit the FDIC from charging premiums to institutions that are well capitalized and highly rated by supervisors as long as the insurance fund is above 1.25% of insured deposits.

Though the deposit insurance system appears to be in a very strong position, there are a number of factors that could affect its solvency. First, there were six insured banks closed because of financial difficulties in 2000, three in 2001, and ten in 2002. These ten banks had total assets of over $2.5 billion. Of the ten failures in 2002, five involved insured deposit payouts, the first since 1993. The number of problem institutions has increased from 74 in 2000 to 124 in 2002 (FDIC, 2002). Second, the insurance fund (BIF) as a percentage of insured deposits has fallen from a high of 1.38% in 1997 and 1998 to 1.25% in 2002 (FDIC, 2002). Third, as more non-banks gain access to deposit insurance, there is the potential for large amounts of money to flow out of brokerage accounts into FDIC-insured accounts. This may cause concern that the insurance reserve ratio will approach the minimum, which could lead to an increase in deposit insurance premiums. The passage of the Gramm-Leach-Bliley Act (Financial Services Modernization Act) in 1999 also causes some concern about risk-taking, particularly by large banking and financial holding company organizations. These large organizations can now more easily control large insurance and securities firms. If these nonbanking firms fail, the health of the entire banking organization could be jeopardized.

In 2001, the FDIC released a recommendations paper which laid out recommendations for merging the insurance funds (BIF and SAIF), eliminating the reserve ratio as the trigger for charging premiums, considering reinstating rebates if the merged fund grows too rapidly, and indexing insurance coverage. The paper also recommended charging regular, risk-based insurance premiums to all insured banks (FDIC, 2001). Reforms may help maintain the proper incentives for risk and reward to insured institutions, as well as fairness among institutions that present different levels of risk to the system (FDIC, 2000).

This paper explores the relationship between deposit insurance premiums and bank risk over the period of 1972-1995. Higher deposit insurance premiums may cause banks to choose riskier portfolios, which will affect profits, the variability of those profits, and asset and liability choices. A simultaneous equations model of the risk-return and asset-liability structure of banks is posited and the impact of premium levels on bank risk measures is directly estimated. Estimation results indicate that bank risk increased during the period and structural results suggest that the implementation of risk-based capital requirements resulted in reduced bank risk taking.

Theoretical Considerations

Flat-rate deposit insurance creates managerial incentives that promote unwanted risk-taking by financial institutions. That notion is widely accepted in the academic literature (Kareken and Wallace, 1978; Merton, 1977, 1978; and Keeton 1984). Without deposit insurance, financial institutions are subject to potential market discipline, which acts to constrain risk-taking behavior. Deposit insurance turns once risky customer deposits into riskless sources of funds.

Merton (1977) was the first to model deposit insurance as a put option issued by the FDIC but held by the bank equity holders. Profits obtained from lending and other activities funded with the guarantee accrue to the shareholders but losses can be put to the FDIC in case things do not work out as planned. Merton showed that the value of deposit insurance to bank stockholders increases with asset risk and leverage. So, by monitoring these variables an insurer can measure and control its loss exposure.

One way that deposit insurance provides an avenue for increased risk-taking behavior is unhinging the cost of funds from the risk level of the asset portfolio. This implies that banks may react differently than expected to exogenously imposed cost increases. Kahane (1977), Koehn and Santomero (1980), and Kim and Santomero (1988) demonstrated that utility-maximizing banks operating under a fixed-rate premium system will increase the level of riskiness of bank assets to achieve desired return levels when capital adequacy requirements and other regulatory costs (such as deposit insurance premiums) are increased. The problem lies in the timing between when the premiums are levied and when institutions are examined. Levying a premium without immediate enforcement induces institutions to seek to take on more risk for a given premium structure.

Genotte and Pyle (1991) demonstrated that externally imposed costs can lead to banks adopting higher risk profiles whether those costs are higher than capital requirements or other regulatory costs (such as deposit insurance premiums). Results of the Genotte and Pyle (1991) study indicate that required increases in bank capital are not a substitute for the monitoring and control of assets risk by bank regulators and may actually imply an increased need for the surveillance of bank asset risk. With such a framework, the deposit insurance system could become pro-cyclical in the sense that failures in the industry are met with higher premiums which, in turn, lead to greater risk-taking.

Shiers (1994) used a theoretical model where the bank maximizes utility, which is a function of expected return and risk. When deposit insurance premiums are not risk-adjusted, a bank can invest in assets with a higher expected return and higher risk without paying a higher rate on deposits. According to Shiers, with an increase in deposit insurance coverage comes the incentive for the bank to choose a portfolio with higher expected return and risk. If more deposits are insured, the cost of deposit insurance to the bank increases. Thus, when deposit insurance premiums increase, banks will also have the same incentives to increase risk to achieve the desired return levels.

Kane (1995) summarized much of this literature by drawing an analogy between federal deposit insurance and a trilateral performance bond in which the deposit insurer provides a bond that protects depositors against poor performance by the bank, while the institution receives a credit enhancement that lowers its funding costs. In this type of setting, where there are incentive conflicts between parties, regulators lack the incentives to enforce effective loss-control measures. Traditional deposit insurance models (including options models) portray capital requirements as an effective and efficient means of limiting taxpayer loss exposure in deposit insurance, which Kane says is misleading because these models treat risk as exogenous and underestimate the enforcement difficulty associated with capital requirements. The trilateral bond model acknowledges risk endogeneity and incentive conflicts between parties to the bond and emphasizes the need for stricter loss-control activity.

Although risk-based capital requirements were initiated in the late 1980s and risk-based deposit insurance premiums were imposed in 1993, their presence has not eliminated the pro-cyclical bias discussed earlier. Riskier banks are still required to pay higher costs once the risks are recognized.

Evidence on the effectiveness of regulatory changes in reducing bank risk is mixed. Hovakimian and Kane (2000), using an options pricing model, found that capital regulation has failed to control the risk-shifting incentives of deposit insurance and, though regulatory changes have improved capital discipline, risk-shifting incentives have not been eliminated. Weaknesses in deposit insurance pricing and capital supervision encourage banks to extract deposit insurance subsidies by increasing their risk exposure. Though regulatory changes have improved capital discipline, regulators still do not adequately monitor and respond to changes in the riskiness of bank asset returns. Benston (1998) suggested that since the implementation of FDICIA, deposit insurance has been put on a more workable, incentive-compatible basis that should discourage banks from taking excessive risks and prevent regulators from delaying the imposition of penalties on poorly capitalized institutions. The prompt corrective action and least cost resolution provisions appear to have some success in resolving agency problems previously associated with deposit insurance.

Hovakimian and Kane (2000) warn that risk remains mispriced at the margin and as long as banks remain well capitalized the pricing weakness may not be apparent. But, in a sharp interest rate swing or business cycle downturn where banks sustain large losses, the FDIC's condition could deteriorate.

Simultaneous Equations Models

The nature of the banking firm leads to simultaneous decisions involving the bank balance sheet. Baltensperger (1980) and Santomero (1984) provided comprehensive surveys of models of the banking firm and related descriptions of bank behavior. Many of the important elements of the economic structure underlying bank behavior have been illustrated by using a portfolio theory approach. Santomero (1984) provided a concise description for the construction of and solution for these types of models. Clark (1986) provided a theoretical framework that illustrates the simultaneous nature of bank balance sheet and income statement decisions. Clark used a portfolio theory approach to illustrate the important elements of the economic structure of bank behavior. The model applies the general theory of portfolio behavior under the assumption of risk aversion. He used a utility maximization model to show that income and expenses for a bank depend to a large extent on the composition of the bank balance sheet. Bank ROA's are highly dependent on asset and liability decisions. The underlying economic structure of banking behavior results in simultaneous determination of assets and liabilities and the nature of the bank's risk-return profile. Therefore, the deposit level a bank carries on its balance sheet in part determines the deposit insurance premium it must pay, which in turn affects the profitability of the bank. The hypothesis of this study is that higher deposit insurance premiums caused banks to increase their risk-taking activities to attain their desired rate of return given the increased premium expense.

The Structural Specification

The above discussion indicates that bank profitability is simultaneously determined with the composition of the bank's balance sheet and the risk level of the portfolio. We specify a set of structural equations that follow previous research and encompass the general areas of bank policy decisions (liquidity, lending, investment, and capital adequacy); the risk/return preferences of the bank's managers (owners); and market, regulatory and organization structure variables that may have an impact on return and cost attributes of bank assets and liabilities. The model allows for simultaneity between bank risk and return and balance sheet structure while controlling the effects of policy variables, such as the deposit insurance premium.

We initially specify a four-equation model that takes into account the risk-return tradeoff for the bank along with a broad asset-liability choice framework. The four-equation model includes return, risk, and asset and liability composition as endogenous variables (See Clark, 1986). The return equation is specified as a function of the internal characteristics of a bank including the risk level, asset and liability composition, capital adequacy and asset quality along with external factors including short-term interest rates, bank size and the level of deposit insurance premiums. The risk equation relates variation in bank returns to the internal factors of level of return, asset composition, asset quality, and external conditions related to the level of short-term interest rates, size, the level of deposit insurance premiums and a dummy variable that captures the time period when risk-adjusted capital requirements were in effect. The asset composition equation specifies the proportion of assets in loans as a function of internal considerations including the asset risk level, liability composition, capital adequacy, returns on existing securities and on loans and external considerations of the level of short-term interest rates, size and the level of deposit insurance premiums. Finally, the liability composition of the bank is specified as a function of the risk level, asset composition, existing cost of deposits as well as market interest rates, size and deposit insurance costs.

The initial structural equations are written as:

Return:

$$\begin{aligned} ROA = a_0 + a_1 CVROA + a_2 LTA + a_3 DTL + a_4 LDIP + \\ + a_5 PLL + a_6 SIR + a_7 SIZE + a_8 CAR + e_1 \end{aligned} . \quad (1)$$

Risk:

$$\begin{aligned} CVROA = b_0 + b_1 ROA + b_2 LTA + b_3 LDIP + b_4 PLL + \\ + b_5 SIR + b_6 ROA + b_7 CAR + b_8 DRISK + e_2 \end{aligned} . \quad (2)$$

Asset Composition:

$$\begin{aligned} LTA = c_0 + c_1 CVROA + c_2 DTL + c_3 LDIP + c_4 SIR + \\ + c_5 SIZE + c_6 CAR + c_7 IOS + c_8 IFL + e_3 \end{aligned} . \quad (3)$$

Liability Composition:

$$DTL = d_0 + d_1 CVROA + d_2 LTA + d_3 LDIP + d_4 SIR + d_5 SIZE + d_6 PTS + e_4 . \quad (4)$$

The endogenous variables ROA (return on assets), CVROA (coefficient of variation of ROA), LTA (loans to total assets), and DTL (deposits to total liabilities), represent measures of return (profitability), risk, asset composition, and liability composition for portfolios of banks in the sample.

Portfolios of banks were utilized in the estimation of the model instead of individual banks for two reasons. First, because so few banks have publicly traded equity, no contemporaneous risk measure such as the implied volatility from an options-pricing model could be calculated in those banks. Instead, banks were placed into twenty equally sized portfolios for each year of the study to allow for calculation of a contemporaneous risk measure – the cross-sectional coefficient of variation of ROA (CVROA). Second, the large sample of over 10,000 banks per year would have likely resulted in statistical significance for all coefficients. Our variable definitions thus reflect the portfolio aggregation.

ROA is the average end of year ratio of net income to assets for banks in the portfolio, which is employed as the measure of bank profitability. Lindley, Verbrugge, McNulty, and Gup (1992) used ROA as the return measure instead of ROE because of problems that arise when an institution has negative net worth or net worth very close to zero[1]. The coefficient of variation of return on assets, the ratio of the standard deviation of ROA to ROA, is used as the risk measure (CVROA). Clark (1986) used the standard deviation of return on equity as the risk measure, while Hovakimian and Kane (2000) used the standard deviation of asset returns as a risk measure. Shiers (1994) estimated a single equation model and looked at both the coefficient of bank profits variation and the standard deviation of bank profits as risk measures. He concluded that the coefficient of variation is the more appropriate measure[2].

The balance sheet composition of the bank utilizes both an asset and a liability measure. LTA is the average ratio of total bank loans to total assets for each bank in the portfolio. This is used as a proxy for the composition of bank assets. DTL is the average ratio of time and savings deposits to total liabilities for each bank in the portfolio, which is used as a proxy for the composition of bank liabilities.

Exogenous variables include the effective deposit insurance premium[3] (LDIP) along with short-term interest rates (SIR), the capital adequacy ratio (CAR), loan quality as measured by the provisions for loan losses to total loans (PLL), interest income on loans to total loans (IFL), interest on securities to total securities (IOS), the cost of deposits as measured by interest paid on deposits to total deposits (PTS), bank size (SIZE) (in $1000) and a dummy variable (DRISK) that takes on a value of one in those years where risk-based capital standards were in effect. The exogenous variables PLL, IFL, IOS and PTS are internal cost and revenue measures that would be expected to influence the asset-liability composition of the bank as well as the risk and return profile. The exogenous variables SIR, CAR, LDIP, CAR and DRISK are included as measures of market, regulatory and institutional characteristics that will influence the balance sheet and risk-return choices.

PLL is the average ratio of provision for loan losses to total loans for the portfolio and is used as a proxy for the quality of the loan portfolio. The loan loss provision is expected to be positively related to the asset risk measure (CVROA) and negatively related to the return measure (ROA). A higher provision for loan losses should indicate that the bank perceives its loan portfolio to be riskier with a greater potential for loss.

The average ratio of year-end interest and fees on loans to total loans (IFL) is a proxy for the average interest rate received on the loan portfolio. The higher the level of interest and fees banks receive on loans, the more loans they are likely to carry because banks tend to act as price setters in loan markets. Thus, the average interest rate on the loan portfolio is hypothesized to be positively correlated with loans to total assets (LTA).

IOS is the average ratio of year-end interest received on securities (US Treasury, other US Government, and corporate) to the total dollar volume of these securities. This is utilized to capture the effect of other asset returns on the composition of the bank's asset portfolio. We expect this variable to be negatively related to LTA because banks are more likely to carry higher levels of loans when returns on alternative assets are lower.

The effects of differences in costs of acquiring time and savings deposits on the composition of bank liabilities is measured by PTS, the average ratio of year-end interest paid on time and savings deposits to total time and savings deposits. Because banks tend to act as price takers in the

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[1] A negative net worth and a negative net income produce a positive ROE. Also, if net worth is close to zero, small profits or losses can lead to extreme values for ROE.

[2] The coefficient of variation is more appropriate as the risk measure because, according to Shiers (1994), "of the two measures of risk, the FDIC probably is more concerned with the coefficient of variation because the likelihood of a bank failing is directly related to the amount of risk per unit of return" (page 351).

[3] The deposit insurance premium is lagged one period to allow banks time to react to deposit insurance premium changes. The effective premium paid in each period was determined at the end of the period when rebates, if any, were granted. We also used the effective deposit insurance premium in the current year with no qualitative change in the results.

savings markets, higher rates paid on deposits attract more deposits. We therefore expect PTS to be positively related to the ratio of time and savings deposits to total liabilities (DTL).

LDIP is the effective deposit insurance premium lagged one year. We use such a lag because the rebate provided to banks by the FDIC was determined at the end of the year once losses for the year could be forecast. As the effective insurance premium rises, the bank may have the incentive to shift to a riskier asset portfolio to achieve its desired rate of return, which implies a positive relationship with bank risk (CVROA) and loans to total assets (LTA). The imposition of additional costs in the form of deposit insurance premiums should lead to a reduction in the bank's return on assets. However, if the bank shifts to a riskier asset portfolio, this could lead to an increase in ROA. Thus, the relationship between the deposit insurance premium and ROA is ambiguous. We also expect LDIP to be inversely related to the ratio of deposits to total liabilities (DTL). The higher the deposit insurance premium, the higher the cost of deposits is and the greater the likelihood the bank will shift to non-deposit sources of funding.

A short-term interest rate (SIR), the average 3-month CD rate, is included in order to control market influences in yields (Lindley et al., 1992 and Shiers, 1994). Because higher market rates usually lead to higher returns on investments, we expect SIR to be positively related to ROA. Higher interest rates in general may result in banks investing in less risky assets because they can meet their yield objectives more easily with safer investments. This implies negative relationships with asset risk (CVROA) and loans to total assets.

The capital adequacy ratio or average ratio of net worth to total assets (CAR) is included as a measure of the effect of regulatory capital standards on bank risk and return (Lindley et al., 1992, and Graddy and Kyle, 1986). We expect increased capital holdings to be negatively related to ROA, CVROA, and LTA because highly capitalized banks are generally more conservative and would tend to have lower risk, fewer risky assets, and lower returns.

Average total assets (SIZE) are included to control differences in investment opportunities (Lindley et al., 1992, and Clark, 1986). Bank size is expected to be positively related to ROA because large banks often have more investment opportunities than smaller ones, and therefore can achieve higher returns while taking less risk (negative correlation with risk (CVROA)). Larger banks tend to invest in more loans than smaller banks, thus the hypothesized positive relationship between LTA and SIZE. Deposits to total liabilities (DTL) and bank size are hypothesized to be negatively related because larger banks have greater access to purchased liabilities in the money and capital markets than smaller banks do, so larger banks rely more on purchased funds and less on deposits than smaller banks.

A dummy variable (DRISK) to note the time period when risk-based capital standards were in effect was also included. If risk-based capital standards had their desired effect, the sign on this dummy variable should be negative in the risk equation (See Jacques and Nigro, 1997 and Haubrich and Wachtel, 1993).

Structural Versus Reduced Form Considerations

Because endogenous variables appear on both sides of the equations, the influence of an exogenous variable is both direct and indirect. The interpretation of a structural coefficient is that it represents the partial effect of an exogenous variable on the left-hand side endogenous variable in a particular equation. The total effect of an exogenous variable on an endogenous variable must be obtained from the reduced form coefficients. The reduced form coefficients measure the impact of a change in a predetermined variable after it has fully worked its way through the posited bank structure. Thus, it is important to analyze the significance of the derived reduced form coefficients to determine the total effect of all predetermined variables on an endogenous variable (Ford and Jackson, 1998).

Our primary interest in this study is in the impact of premium changes on our measure of bank risk. In our structural model we have posited both direct and indirect effects. To capture the total impact we will focus our attention on the derived reduced form coefficients as opposed to the structural coefficients. That impact is measured by the reduced form coefficient on deposit insurance premiums in the reduced form risk equation. Similarly, we measure the impact of risk-based capital requirements on bank risk by the reduced form coefficient on the dummy variable in the risk equation. Following Gennotte and Pyle's (1991) argument, we anticipate that the reduced form coefficient on the deposit insurance premium variable in the risk equation will be positive, suggesting a pro-cyclical type of effect. We also expect the reduced form coefficient on the dummy variable in the risk equation will be negative which would indicate that risk-based regulatory measures would have the desired risk-reduction effects.

Data and Empirical Results

All banks reporting on the FDIC Call and Income Reports for the period of 1972-1995 were included in this analysis. Banks were ranked by asset size in each period and the sample was partitioned into twenty equally sized portfolios (after accounting for missing data) for each year of the study to allow for calculation of the cross-sectional coefficient of variation of ROA (CVROA). Portfolio composition was allowed to change from period to period.

All bank performance variables described earlier (ROA, CVROA, LTA, DTL, PLL, CAR, SIZE, IOS, IFL, and PTS) were constructed for the portfolios from data collected from the FDIC Call and Income Reports. These ratios were calculated as the equally weighted averages of the cross-sectional observations for each portfolio. The coefficient of variation for the portfolio is calculated by using the ROA values for each bank in the portfolio and is thus a cross-sectional measure. Deposit insurance premium data were obtained from FDIC Historical Statistics on Banking with the effective rate calculated as the proposed rate at the beginning of the year less the end-of-year rebate. The premium was then lagged one year to account for the lateness of the rebate. Table 2 contains effective deposit insurance rates from 1972 to 1995. The average annual 3-month CD rate was obtained from the Federal Reserve Bank of St. Louis (FRED) database. Descriptive statistics for the variables used in the model are found in Table 3[1].

Table 2

Effective Deposit Insurance Rates, 1972-1995

Year	Effective Assessment Rate, %
1	2
1972	0.0333
1973	0.0385
1974	0.0435
1975	0.0357
1976	0.0370
1977	0.0370
1978	0.0385
1979	0.0333
1980	0.0370
1981	0.0714

[1]The negative mean for CVROA is caused by a small number of extremely CVROA negative values when the ROA is very near zero. When those observations were eliminated, neither structural nor reduced form estimation results were significantly affected.

Table 2 (continuous)

1	2
1982	0.0769
1983	0.0714
1984	0.0800
1985	0.0833
1986	0.0833
1987	0.0833
1988	0.0833
1989	0.0833
1990	0.1200
1991	0.2125
1992	0.2300
1993	0.2440
1994	0.2360
1995	0.0400

Effective FDIC deposit insurance premium rates from 1972-1995. The effective rate is calculated as the assessed rate less the annual rebate, if any. Source of the data is the FDIC Annual Report, 1995 FDIC Historical Statistics on Banking.

Table 3

Sample Statistics for Sized Ranked Portfolios of Commercial Banks

	Mean	Standard Deviation	Minimum	Maximum
20 Size Ranked Portfolios of Commercial Banks for years 1972-1995, N=480.				
Return on Assets – ROA	0.0083239	0.0027027	-0.0025714	0.0125366
Loans to Total Assets - LTA	0.526359	0.0380245	0.4006889	0.6547038
Deposits to Total Liabilities - DTL	0.729	0.104	0.445	0.853
Capital Adequacy Ratio - CAR	0.092	0.021	0.645	0.204
Interest From Loans - IFL	0.1051603	0.219382	0.0654705	0.1621263
Cost of Deposits - PTS	0.0613654	0.017214	0.0336128	0.1189974
Provision for Loan Loss - PLL	0.0072206	0.0044643	0.0023048	0.0254565
Lagged Deposit Premium - LDIP	0.8825	0.0680547	0.0333	0.244
Short-term Interest Rate - SIR	7.9272917	3.0530849	3.174	15.991
Average Total Assets - SIZE	174969.36	645507.06	1810.3	5899763.1
Interest on Securities - IOS	0.091581	0.0281929	0.0527188	0.1975586
Coefficient of Variation - CVROA	-7.2101317	370.4467127	-8061.08	179.406486

Mean, standard deviation, minimum and maximum of the variables in our sample for portfolios of US Commercial Banks for years 1972-1995. The source of the data is the 1972-1995 Call Reports, the FDIC Historical Statistics on Banking, and the Federal Reserve Bank of St. Louis database.

The simultaneous equations system was estimated by using the three-stage least squares (3SLS) procedure.[1] Parameter estimates and t-ratios are reported for estimation of the structural form of the model. More importantly for our purposes, the derived reduced form estimates and calculated t-statistics of those estimates are reported. These t-statistics are not directly available from statistical estimation packages, so they were calculated by using a procedure suggested by Theil (1971, p. 537-538).

Structural Equation Results

Results of the 3SLS estimation of the structural form of the model are presented in Table 4. In general, the coefficients have signs consistent with our expectations. In the return equation, the risk measure (CVROA), asset composition (LTA), and capital adequacy (CAR) are positively related to bank profitability (ROA). Hence banks with relatively risker positions are more profitable. The DTL coefficient is also positive and significant suggesting greater profitability for banks funding assets with deposits. The sign of the LDIP coefficient is negative and weakly significant – higher levels of deposit insurance premiums reduce bank profitability.

Table 4

Structural Estimates of the Impact of Deposit Insurance Premium Increases on Bank Risk for Portfolios of Banks

Variable	ROA	CVROA	LTA	DTL
1	2	3	4	5
Intercept	-0.1831***	1050.65***	0.8304***	-0.1086
	(-2.455)	(2.984)	(6.992)	(-0.557)
Return on Assets - ROA	------	-47984.0**	-----	-----
		(-1.965)		
Coefficient of Variation - CVROA	0.0001***	-----	-0.0002**	-0.0002***
	(2.063)		(-2.551)	(-2.780)
Loans to Total Assets - LTA	0.2301***	-783.783	-----	1.8505***
	(4.658)	(-0.905)		(3.432)
Deposits to Total Liabilities - DTL	0.0806***	-----	-0.3582***	-----
	(2.092)		(-5.290)	
Lagged Deposit Premium -LDIP	-0.1373*	2401.75***	0.6695***	1.3426***
	(-1.732)	(2.953)	(4.314)	(9.973)
Provision for Loan Loss - PLL	-0.4471	-38270.0***	-----	-----
	(1.043)	(-3.597)		
Short-term Interest Rate - SIR	-0.0006	16.495	0.0037*	-0.0156***
	(-0.995)	(1.555)	(1.885)	(-3.759)
Capital Adequacy Ratio - CAR	0.4567*	-4275.5***	-2.1094***	-----
	(1.755)	(-3.231)	(-3.393)	
Average Total Assets - SIZE	-0.0008	14.984	0.0042	-0.0486***
	(-0.585)	(0.728)	(0.772)	(-3.865)

[1] Two-stage least squares estimators are consistent estimators for unknown parameters in identified or overidentified structural equations. While the estimator for each equation makes use of information for all the exogenous and predetermined variables in the system, it ignores information concerning endogenous variables that appear in the system but not in the equation. 2SLS also ignores information that may be available concerning the covariances across equations. The balance sheet and income statement link the four equations in this model. As such, the error terms across the equations are likely to be correlated, making 3SLS more appropriate than 2SLS. In addition, the calculation of the t-statistics for the derived reduced form coefficients requires use of 3SLS.

Table 4 (continuous)

1	2	3	4	5
Interest From Loans - IFL	-----	-----	0.0811	-----
			(0.398)	
Interest on Securities - IOS	-----	-----	-0.0338	-----
			(-0.586)	
Costs of Deposits - PTS	-----	-----	-----	6.1000***
				(7.953)
Dummy for Risk-Based - DRISK	-----	-258.02***	-----	-----
		(-3.991)		

Three stage least squares estimates of the structural coefficients of market and regulatory variables on the return, risk, asset choice and liability choice of 20 bank portfolios from 1972 to 1995. The data were obtained from the 1972-95 Call Reports, the FDIC Historical Statistics on Banking and the Federal Reserve Bank of St Louis database. N = 480.

T-statistics in parentheses.

*Statistically significant at the 10% level.

**Statistically significant at the 5% level.

***Statistically significant at the 1% level.

In the asset equation, higher short-term interest rates and deposit insurance premiums both positively impact the loan to asset ratio. This appears to be consistent with notions of loan profitability in rising interest rate environments and reformulation of the portfolio towards lending in the face of higher insurance costs. The risk, liability structure, and capital adequacy variables all negatively impact the loan to asset ratio.

In the liability equation, all of the coefficients are statistically significant. The coefficients on the asset risk, short-term interest rate, and size variables are all negative. Larger banks, higher rates, and greater risk-taking all appear to reduce the importance of deposit financing. The remaining variables all positively impact the ratio of deposits to liabilities. We expect higher lending to increase deposit needs but the signs on the cost of deposits (PTS) and the insurance premiums seem puzzling although this could indicate deposit growth in an expansionary economy.

In the risk equation, the return, capital adequacy and loan loss provision variables are all negatively related to the risk measure. The critical variables of interest – deposit insurance (LDIP) and risk-based capital adequacy dummy variable (DRISK) – both have the anticipated signs. Higher premiums are positively related to bank risk and risk-based capital requirements appear to have decreased bank risk.

Reduced Form Results

While the coefficients on the insurance premium and the risk-based capital dummy variable in the structural equations have the predicted partial effects on our risk measure, it is not clear that the total effects are in the directions indicated. The insurance premium was also modelled to impact the other endogenous variables in the model. This will feed back through the system to ultimately impact risk again. Similarly, the risk-based capital dummy variable has feedback effects through the impact of risk on the other endogenous variables.

The derived reduced form estimates take this feedback into account and are presented in Table 5. Notice that few of the exogenous variables retain their statistical significance when their impact is allowed to interact with the other variables in the model. Importantly however, the sign on the deposit insurance premium variable is positive and significant in the risk equation. Higher premiums appear to lead to riskier choices on the part of banks and hence could have a pro-cyclical type of impact. The coefficient on the risk-based capital standards dummy variable is no longer significant at standard levels.

Table 5

Derived Reduced Form Estimates of the Impact of Deposit Insurance Premium Increases on Bank Risk for Portfolios of Banks

Variable	ROA	CVROA	LTA	DTL
Intercept	0.0086	249.4043	0.4945***	0.7370*
	(0.761)	(0.360)	(6.312)	(1.852)
Lagged Deposit Premium -LDIP	0.0250***	1219.76***	-0.0248	0.9572***
	(2.744)	(2.943)	(-0.0311)	(3.371)
Provision for Loan Loss - PLL	-0.0561	-1247.47	1.4135	6.0894
	(-1.260)	(-0.445)	(0.407)	(0.412)
Short-term Interest Rate - SIR	0.0003	-0.6188	0.0056***	-0.0050
	(1.232)	(-0.039)	(3.029)	(-0.670)
Capital Adequacy Ratio - CAR	-0.0251	-2326.85	-0.9509	-1.1118
	(-0.339)	(-0.509)	(-1.59))	(-0.448)
Average Total Assets - SIZE	0.0001	-1.5856	0.0132**	-0.0238
	(0.171)	(-0.035)	(2.168)	(-0.962)
Interest From Loans - IFL	0.0122	-687.725	0.1267	0.4260
	(0.362)	(-0.364)	(0.365)	(0.348)
Interest on Securities - IOS	-0.0051	286.777	-0.5285	-0.1776
	(-0.453)	(0.526)	(-0.531)	(-0.492)
Costs of Deposits - PTS	0.0025***	-1000.13***	-1.4231***	3.1804***
	(7.695)	(-3.913)	(-3.175)	(-6.262)
Dummy for Risk-Based - DRISK	-0.0017	-191.460	0.0217	0.0934
	(-0.599)	(-1.277)	(0.941)	(0.975)

Three stage least squares estimates of the reduced form coefficients of market and regulatory variables on the return, risk, asset choice and liability choice of 20 bank portfolios from 1972 to 1995. The data were obtained from the 1972-95 Call Reports, the FDIC Historical Statistics on Banking and the Federal Reserve Bank of St Louis database. N = 480.

T-statistics in parentheses.

*Statistically significant at the 10% level.

**Statistically significant at the 5% level.

***Statistically significant at the 1% level.

In the return equation, the reduced form deposit insurance coefficient is opposite in sign of the structural coefficient. When the full impact of exogenous variables is measured, higher premium levels are associated with higher profitability. Presumably, the higher risk associated with the higher premiums also results in higher realized returns as well. Somewhat surprisingly, the total impact of higher effective premium is to increase the proportion of deposits in the liability structure. The riskier portfolio is evidently financed with liabilities that are insensitive to the overall risk of the bank. The results also indicate the bank size variable is positively related to the loans to total asset choice (greater lending opportunities for larger banks) while it was not significant in the structural estimation.

The other significant variables in the reduced-form results are a positive relationship between short-term interest rates (SIR) and the loan to asset ratio (LTA) and a negative relationship between the average cost of deposits (PTS) and LTA. Higher rates are typically associated with an expansionary economy and hence the coefficient may indicate more overall lending opportunities for banks.

Alternative Specifications

Earlier we described the four-equation model that we specified to account for the risk return and balance sheet choices of the bank. We next examined different model specifications suggested in literature on finance.

Following the early literature we include capital as an exogenous variable. More recent works by Shrieves and Dahl (1992) and Aggarwal and Jacques (2001) consider capital as an endogenous variable in the specification of the model.

Hence we postulated and estimated a five equation structural model specified as follows:[1]

Return:

$$ROA = a_0 + a_1 CVROA + a_2 LTA + a_3 CAR + a_4 LDIP + \\ + a_5 PLL + a_6 SIR + a_7 SIZE + e_1 . \quad (5)$$

Risk:

$$CVROA = b_0 + b_1 LTA + b_2 CAR + b_3 LDIP + b_4 PLL + \\ + b_5 SIR + b_6 SIZE + b_7 DRISK + e_2 . \quad (6)$$

Asset Composition:

$$LTA = c_0 + c_1 CVROA + c_2 DTL + c_3 CAR + c_4 LDIP + \\ + c_5 SIZE + c_6 IOS + c_7 IFL + e_3 . \quad (7)$$

Liability Composition:

$$DTL = d_0 + d_1 CVROA + d_2 LTA + d_3 LDIP + d_4 SIR + d_5 SIZE + d_6 PTS + e_4 . \quad (8)$$

Capital Composition:

$$CAR = g_0 + g_1 CVROA + g_2 LTA + g_3 LDIP + g_4 SIR + \\ + g_5 SIZE + g_6 DRISK + g_7 PTS + e_5 . \quad (9)$$

The model was estimated by using the same bank portfolios over the same time period as in the original model. We do not report the structural estimates as our interest is in the reduced form coefficients. The reduced form results are reported in Table 6. As was the case earlier, the particular variables of interest are the deposit insurance premium variable and the dummy variable for the period when risk-based capital standards were in effect. As was the case in the four-equation model, the deposit insurance variable is positive and significant in the risk equation. In addition, the risk-based dummy variable now carries a significant negative coefficient suggesting those regulatory changes had the desired effect of reducing bank risk.

Following Houston, James, and Marcus (1997) and Houston and Marcus (1998) we employed cash flow to assets as an alternative measure for bank returns. They suggest cash flow as the more appropriate measure because net income includes the impact of the provision for loan loss. While we do not report the results here, they were qualitatively the same as in our original specification for the insurance premium and risk-based capital variables.

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[1] The structural specifications of some of the equations were altered slightly to avoid identification problems.

Table 6

Derived Reduced Form Estimates of the Impact of Deposit Insurance Premium Increases on Bank Risk for Portfolios of Banks

Variable	ROA	CVROA	LTA	DTL	CAR
Intercept	0.0066**	-34.297	0.5126***	0.3743***	0.0082***
	(2.32)	(-0.62)	(12.06)	(7.06)	(5.17)
Lagged Deposit Premium -LDIP	0.0145	801.35***	-0.827	0.6268**	0.0804
	(1.52)	(3.00)	(-0.52)	(2.37)	(0.72)
Provision for Loan Loss - PLL	-0.5685***	-6317.92	-3.1723	6.4657***	1.9443
	(-3.97)	(-1.58)	(-1.36)	(2.61)	(1.46)
Short-term Interest Rate - SIR	0.0001	-8.8548	-0.0022	-0.0116	0.0032
	(0.24)	(-0.96)	(-0.30)	(-1.40)	(1.09)
Average Total Assets - SIZE	0.0037	3.7642	0.0276***	-0.0456***	-0.0076
	(0.66)	(0.23)	(2.98)	(-2.99)	(-1.26)
Interest From Loans - IFL	0.0483	-951.15	0.7669	0.7756	-0.127
	(1.25)	(-1.41)	(1.26)	(0.99)	(-0.35)
Interest on Securities - IOS	0.0144	-283.08*	0.2283	0.2308	-0.0380
	(1.51)	(-1.75)	(1.48)	(0.76)	(-0.38)
Costs of Deposits - PTS	-0.0387	3670.4***	-0.8011	3.5039	-0.4151
	(-0.27)	(2.43)	(-0.39)	(1.08)	(-0.43)
Dummy for Risk-Based - DRISK	-0.0014	-113.31***	0.0132	0.1048***	0.0019
	(-1.36)	(-3.10)	(0.77)	(5.59)	(0.19)

Three stage least squares estimates of the reduced form coefficients of market and regulatory variables on the return, risk, asset choice and liability choice of 20 bank portfolios from 1972 to 1995. The data were obtained from the 1972-95 Call Reports, the FDIC Historical Statistics on Banking and the Federal Reserve Bank of St Louis database. N = 480.

T-statistics in parentheses.

*Statistically significant at the 10% level.

**Statistically significant at the 5% level.

***Statistically significant at the 1% level.

We also looked at the sensitivity of our results to bank size. Even though we controlled the average size of the portfolios we attempted to determine if our results were sensitive to bank size. To do this we took the time series size average of our portfolios and then did pair-wise tests of successive portfolios to see where they differed significantly. Statistically, the 18th and 19th largest portfolios differed in average total assets. We then estimated the models using the 18 smallest portfolios (we did not have sufficient observations to separately estimate the two largest portfolios). The model estimation results differ only slightly for the sample of "small" bank portfolios than for the total sample. In the original model, the lagged deposit insurance premium (LDIP) reduced-form coefficient is positive but not significant in the risk equation (CVROA). In the five-equation model, the reduced-form coefficient on LDIP is positive in the risk equation but only weakly so. The reduced-form coefficient on the dummy variable for the implementation of risk based capital standards (DRISK) is now negative and significant in the risk equation in both the four and five-equation model (it was previously only significant in the five-equation model). These results indirectly suggest that large banks have a marginal influence – potentially driving the significance of the regulatory variables. Small banks alone are less likely to take on more risk in the face of higher deposit insurance premiums and have reduced risk in response to the implementation of risk-based capital standards. Finally, along similar lines, we re-estimated the original model eliminating the observations that caused the negative mean for CVROA (See endnote 4). The negative and very small ROA values occurred in the portfolios of small banks during the middle to late 1980's. When the small portfolios were eliminated for all years and the model was re-estimated by using the 16 largest portfolios, neither structural nor reduced form estimation results were significantly affected.

Conclusions

The interdependent nature of bank asset and liability decisions as well as risk-return characteristics suggest that the appropriate empirical analysis of bank decisions is best accomplished with a simultaneous equations system. A structural model was estimated via three-stage least squares to determine the impact of deposit insurance premium changes on bank risk. Derived reduced form coefficients were estimated, and significance tests were calculated to determine the total, not partial, effect of the premium changes on bank risk.

Estimation of the structural model provides results indicating that increases in deposit insurance premiums actually increased bank risk. The structural results also suggested that the implementation of risk-based capital requirements resulted in reduced risk taking.

More importantly, the derived reduced form estimates related to deposit insurance were consistent with our expectations. The deposit insurance premium coefficient remained positive and significant in the risk equation. The dummy variable on the implementation of risk-based capital standards was no longer statistically significant with the feedback effects.

We also examined alternative specifications of the simultaneous equation model. In particular, when capital levels were treated as endogenous to the system, the reduced form coefficients on both the deposit insurance premium and the dummy variable on risk-based capital were significant and of the anticipated sign. We also examined the robustness of the results by estimating the model for just small bank portfolios. Excluding large banks portfolios has the impact of reducing or eliminating the significance of the deposit insurance premium variable in the risk equation and increasing the significance of the impact of risk-based capital standards.

These results suggest that policy makers face difficult choices in periods of banking crises. Implementing policies designed to reduce risk-taking behavior that exogenously raise costs may actually promote risk-taking to retain profitability levels. The banking industry might be better served by implementing such policies during periods of strong profitability so their negative consequences are minimized. While difficult to implement, deposit premiums or closer scrutiny to loan losses should occur when least needed.

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