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STAFF MEMORANDA

BANK SOUNDNESS AND THE MARKET FOR LARGE NEGOTIABLE CERTIFICATES OF DEPOSIT

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Bank Soundness and the Market for Large Negotiable Certificates of Deposit

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I. Introduction

Several recent studies have investigated whether or not financial markets respond to increased bank riskiness by demanding higher expected or promised rates of return on bank liabilities. Were commercial banking not such a heavily regulated industry, the answer to this question would be obvious: securities issued by riskier firms must promise higher returns. Banking is heavily regulated, however, and is regulated in nearly every facet of operation. Banks cannot come into existence without governmental sanction, cannot locate new offices or change the location of existing offices without approval, face restrictions on prices of their outputs and on prices they can pay for inputs, and cannot indeed even go out of business unless regulators allow it. The fact that opportunities for banks to fail are circumscribed has led many to observe that regulation may have dulled financial markets' perceptions of the "true" riskiness of banking.

From a policy standpoint, the implication would be that financial markets do not exert a restraining influence over bank asset expansion. Although much of the history of bank regulation in the United States has been predicated on the notion that financial markets cannot police bank soundness, to the financial economist this notion makes little sense. One expects, on the contrary, that markets and regulators are engaged in duplicative activities.

To date, nearly all empirical tests of the pricing of bank risk-taking have examined markets for equity or long-term debt. While equity markets are believed to be highly efficient, an equity-oriented test has the difficulty that there exists no consensus valuation model for the firm. Thus Pettway [20] based his tests on price-earnings ratios and on beta coefficients, while Beighley, Boyd, and Jacobs [2] used price as their dependent variable. Long-term debt markets, on the other hand, are suspected not to be nearly as efficient as equity markets. (i.e., new information may not be as quickly reflected in debt prices). Debt valuation models, however, are agreed to obey a risk-premium or risk-differential format (see [1], [7], [11], [17], [20], [27]), which accords nicely with the capital asset pricing ideas ([15], [19], [25]).

Against this background, the present paper offers a further test of the ability of financial markets to monitor bank soundness. The market on which we have chosen to focus is that for large negotiable certificates of deposit (hereafter CDs). The CD market has the efficiency advantage of equity markets and the valuation advantage of debt markets. That is, many banks compete on the offering side of the market, and many corporations and institutions compete on the bidding side. Moreover, being fixed maturity, fixed interest obligations, a risk premium model can be applied to CDs. Section II presents the model, section III discusses the data and sample construction, section IV gives the empirical results, and section V provides a summation.

II. The Model

The econometric model for this paper is expressed as an offer

function relating the yield on a CD (RCD) to factors external to the bank and to other variables internal to the bank's decision process. We view this estimating equation as the equilibrium solution to a general financing problem, where the bank is assumed to minimize its cost of funds for a given volume and mix of bank output. Factors external to the bank that enter the analysis are the risk-free rate of return (RF) and attitudes of investors toward technical characteristics of securities (indenture provisions) that are unrelated to any particular issuer. Internal factors are the composition of the bank's liabilities, the risk characteristics of its assets, and certain other management decisions concerning the type of business the bank wishes to undertake (e.g., wholesale or retail banking, foreign or domestic-only operations). Although these latter considerations are endogenous to the bank's decision process, they are not endogenous to the model in an econometric sense, since the observable variables from bank balance sheets and income statements represent ex post results of decisions and not ex ante maximands or constraints. Consequently, the econometric model to be estimated should be viewed as a reduced form.

External factors. In other literature on debt valuation models, the dependent variable is written in risk premium form, which here would be RCD - RF. Formulating the model in risk premium form entails the implicit assumption that the regression coefficient of RF is unity. The justifications of this usage are, first, that the risk-free rate of interest by definition must set a floor under borrowing costs to all risky issuers of debt and, second, that Treasury securities typically

enjoy the broadest market of any debt instrument and hence carry the least market risk due to transactions costs. While the probability that a large commercial bank will fail is certainly greater than zero, bank liabilities are widely held to be very nearly riskless as far as default is concerned.[1] Moreover, transactions costs on certificates of deposit may actually be lower than on Treasury securities, since CDs can be issued to mature on any day the investor wishes (provided the original maturity is at least 30 days) and may thus reduce the expected costs of going in and out of cash. Should this effect be empirically significant, the coefficient of RF would be less than unity.

In addition, two other arguments can be advanced why the coefficient of RF should not be constrained. First, institutional peculiarities magnify the differences between Treasury bills and other short-term assets as investment vehicles. The foremost difference is that Treasury bills are satisfactory collateral for secured federal funds transactions and repurchase agreements while most other securities are not. The yield curve for Treasury bills is also notorious for the amount of noise in its short end, which will tend to bias the coefficient of RF downward. Second, corporate taxes can be deferred by investing in Treasury securities, which are taxed on a realized and not on an accrual basis. Since the nature of the sample forced us to use year-end observations on large CDs, such tax considerations may also affect Treasury bill yields. In the empirical section, we will estimate our model with the coefficient of RF both unconstrained and constrained to unity. The empirical results will indicate that the unconstrained version is economically far more sensible.

The only other exogenous factor included in this analysis is term to maturity of the CD (TERM).[2] Attitudes toward the investment horizon reflect investor preferences rather than any characteristic of issuing banks. TERM is included in the regression model so that the CD yield curve is not constrained to be a vertical displacement of the Treasury bill yield curve. The coefficient of TERM is expected to be positive, since one typically expects the probability of default to rise as the time horizon lengthens. In addition, a preference for liquidity on the part of investors suggests a positive coefficient for TERM.[3] Large certificates of deposit are more standardized than most other financial instruments and thus have fewer differentiating indenture characteristics. Such well-known features as callability, convertibility, and sinking fund or other early retirement features do not apply to CDs.

Internal factors. Previous debt valuation studies have focused on leverage as the premiere aspect of bank risk from an investor's point of view. In this study, we define leverage as the ratio of assets to total capital, label this variable ASSETS/CAP, and expect its coefficient to be positive. Leverage, however, is but one aspect of investor risk. While receiving considerable attention in text books on commercial bank management (e.g., [8], chapters 8-9), liquidity has been a neglected consideration in empirical studies of debt markets. Because large CDs, for banks that issue them, represent almost continuously maturing obligations, overall liquidity is especially important for this study. Ultimately, banks have two means for meeting these obligations. First, assets can be sold and the proceeds used to pay depositors. Banks

maintain for just such purposes secondary reserves of marketable securities, foremost of which are short-term U.S. Government securities. For very short investment periods banks can also buy (or cease to sell) federal funds at much lower transactions costs. In addition, most large banks have significant amounts of call loans outstanding to brokers and dealers. These three assets are the basic sources of liquidity in the balance sheet. The two major requirements for liquidity on the liability side are for CDs and for federal funds purchased. Thus, to measure a bank's ability to meet maturing CDs from short-term assets, we net average fed funds purchased against average fed funds sold, add U.S. Government securities maturing within one year and loans to brokers and dealers, and divide the total by CDs maturing within one year (effectively, all CDs). This variable is denoted ASSET LIQ, and its expected sign is negative.[4]

The second method for meeting maturing deposit obligations is to pay them out from earnings. Since CDs are not the only class of liabilities banks must be prepared to redeem, we measure earning power broadly as the net rate of return on assets. Besides indicating a bank's capacity to pay off CDs out of income, rate of return on assets influences ability to attract long-term, subordinated funds such as capital notes or equity. Since subordinated liabilities provide a cushion to CD holders in case of failure, greater ability to attract equity or to issue capital notes should allow the bank to pay lower rates on its CDs. The expected sign of this variable, EARN/ASSETS, is also negative.

Since the rate of return on assets is expected to influence the required yield on bank CDs, one should also control for the riskiness of those assets. Provision for loan losses is bank management's estimate of the expected riskiness of the bank's assets. Rather than measure loan losses as a ratio to total loans, we instead divide provision for losses by total assets (LOAN LOSS). This avoids having to enter a separate variable to control for the loan to total assets ratio.[5]

As suggested by two recent studies, we consider the possibility that the rate of return on a security is affected by the relative supply outstanding. Fair and Malkiel [9] present evidence in an aggregate context for three classes of bonds: government, industrial, and utility.[6] The logic of such supply effects is based upon preferred habitat, or segmented markets, notions. Such an effect might operate at the micro level in either or both of two ways. First, any bank attempting to issue in toto a larger than "normal" quantity of CDs might be forced to pay higher rates. Second, even though overall a bank may not have issued a larger quantity of CDs than normal, at times the quantity outstanding in a given maturity range might be large relative to market norms. For example, Crane [7] reports that professional dealers in CDs believe some banks "overload" the market from time to time, incurring higher costs of funds. To deal with relative supply effects, we have broken down the maturity distribution of outstanding CDs into those maturing in less than three months, those maturing in three to six months, and those maturing in six to twelve months. For each observed

CD, the variable CDSUPPLY measures the issuing bank's share of the total CDs outstanding in the relevant maturity range.[7]

The CDSUPPLY variable, however, is strongly influenced by the size of the issuing firm. Thus, the relative supply effect may be confounded with what might be termed a "relative scale" effect. The expected relationship between CDSUPPLY and yield based upon relative supply considerations is positive, while the likely relationship based upon relative scale considerations is negative: larger banks are widely believed to be immune to failure because regulators would not allow them to fail. If a large enough sample could be assembled for banks all of one size, this difficulty could be avoided. Since that is impossible, we will try to disentangle the effects by subdividing the sample by asset size.

The effect of issuer size on yields is apparently thought to be more important for CDs than for other financial securities. Crane relates that dealers gear their yield quotations to the rates paid by a top tier of banks and presents some evidence to indicate that CD rates tend to cluster in tiers [7, figure 1]. Melton suggests that the emergence of multiple tiers in the CD market during 1973-4 is evidence of the "maturation of the CD as a money market instrument" [18, p. 31] and notes that many other financial markets (commercial paper, for example) classify borrowers into tiers. The distinguishing characteristic of tiers in the CD market, however, is that size is apparently the only classifying parameter. In the empirical section to follow, we will report an analysis of covariance that subdivides

the sample into those banks with assets greater than $25 billion and all other banks. The regression results will thus present detailed information on the effect of bank size and tiering in the market for CDs.

The final internal factor considered in the present analysis is the foreign exposure of the issuing bank. Despite rapid overseas expansion by U.S. banking organizations in recent years, relatively little research has been conducted on the effects of foreign exposure on the riskiness of banks.[8] One can infer the effect investors believe foreign exposure has on the riskiness of commercial banks by including the ratio of foreign assets to total assets in the regression model. At least three effects are possible. First, a risk-reducing diversification effect might be present due to the less than perfect correlation among business cycles domestically and abroad. Such an effect has been noted by Ruckdeschel [24]. Second, banks with considerable overseas operations have enhanced access to foreign sources of funds, particularly Eurodollar borrowings, which might tend to reduce domestic borrowing rates. Third, banks with larger foreign operations are exposed to greater political uncertainties, due both to possible disruptions to the international financial system and to possible internal disruptions in other countries. On balance, it is not clear which of these effects would dominate a priori. Unfortunately, FOREIGN is also highly correlated with asset size of the issuing bank. Again, subdividing the sample will help to separate out the scale effect.

The regression model can, in summary, be written:

$$(1) \qquad RCD = b_0 + b_1RF + b_2TERM + b_3ASSETS/CAP - b_4ASSET\ LIQ - b_5EARN/ASSETS + b_6LOAN\ LOSS \pm b_7CDSUPPLY \pm b_8FOREIGN,$$

where expected signs are as indicated. We assume the model is linear in the variables and estimate the relationship using ordinary least squares.

III. Sample and Data

Obtaining noise-free data on yields for certificates of deposit is the major practical obstacle to implementing such a test. While many large banks publish daily sheets listing offered rates on CDs, these rates may not be satisfactory as market rates since they are manipulated to reflect how eager the bank is to obtain deposits. Even if data on primary market yields for CDs actually sold were available for a large enough sample, it is probable that one would be forced to pool observations for many dates. To do so would entail the added problem of succinctly describing potentially large differences in the shapes and positions of term structures.

The data source used overcomes these two problems, although other difficulties are encountered instead. Observations are culled from December 31, 1977, annual reports of money market mutual funds. The benefits of this procedure are: (1) accounting procedures are reasonably uniform; (2) all market prices pertain to the same term structure; (3) many observations on the same bank are available, helping to identify the external factors; (4) many observations on a given term to maturity and for a given CD size are available, helping to identify the internal bank factors.

In addition to these practical benefits, another of more philosophical importance is that money market mutual funds are among the most sophisticated investors in bank debt. Whenever one models financial markets or uses market data, implicit is some hypothesis concerning the efficiency of the capital market under consideration. Beliefs about the degree of capital market efficiency are usually categorized as being weak, semi-strong or strong according as one believes that present prices incorporate all information available from historical prices, all information available to the public, or all information whether available to the public or not. Since empirical tests have found little reason to believe in the strong form of the efficient market hypothesis, one wishes to restrict his tests to the weak or semi-strong form. The weak form is ruled out in the present study by requiring balance sheet and income data. The advantage, then, of deriving price quotations from money market mutual funds is that these investors are sufficiently large and "wealthy" that they can be expected to obtain all publicly available information. The semi-strong form which our study requires, then, is likely to be satisfied by the observations in this sample.

Balance sheet data are taken from the Reports of Condition and the Large Bank Supplement to the Report of Condition filed quarterly with federal bank regulators and are averages of figures reported as of December 31, 1976, June 30, 1977, and December 31, 1977. Income data are from the Report of Income filed quarterly with federal bank regulators and are averages of figures reported as of December 31, 1976 and December 31, 1977. Yields on Treasury bills (discount basis) are

taken from the Composite Closing Quotations for U.S. Government Securities, published daily by the Federal Reserve Bank of New York, as of December 30, 1977 (a Friday). The bond equivalent yield is calculated using the formula

$$RF = \frac{365r}{360-rd},$$

where RF is the bond-equivalent yield to maturity, r is the yield on a discount basis, and d is term to maturity in days. RCD is also computed as the yield to maturity.

We used advertisements from the popular financial press to assemble a list of money market mutual funds and requested each to send us its most recent quarterly and annual financial reports. Of the 30 funds we contacted, 19 responded. To avoid identification problems stemming from differing valuation dates, we restricted our attention to just 7 mutual funds that had the same annual reporting date. Preliminary data analysis indicated that market prices and yields reported by the larger funds were substantially different from prices and yields reported by the smaller funds.[9] The largest of the small funds had total assets of $68 million, while the smallest of the large funds had total assets of $376 million. Given the wide divergence in fund sizes, we further restricted our attention to the largest three funds, which provide 145 observations on certificates of deposit issued by 30 different banks.

IV. Empirical Results

The results of estimating the relationship discussed in section II are contained in tables 1 and 2. Column 1 of table 1 gives ordinary least squares regression results for the full yield model. Based upon

conventional tests of goodness-of-fit, this model performs admirably. R-square, adjusted for degrees of freedom, is just under 80%, a very high ratio for cross-sectional analyses. The standard error of the estimate is less than 0.08 percentage points, which can be compared with the mean value of the dependent variable of 6.84 percentage points and its standard deviation of 0.17 percentage points. The F test indicates that the regression relationship as a whole is highly significant.

Only two variables in the regression equation fail to bear the hypothesized signs, ASSETS/CAP and EARN/ASSETS, neither of which is significant by usual statistical criteria. Column 2 deletes these variables, and these further results show that parameter estimates are not particularly sensitive to specification. The only variable whose coefficient still fails to exceed its standard error is LOAN LOSS, which is further deleted in the experiment reported in column 3. Comparing summary regression statistics for columns 1 to 3, adjusted R-square is virtually identical and standard errors of estimate are identical to three decimal places. On grounds of economy in specification, column 3 is selected as the most appropriate empirical relationship.

Of the six independent variables shown in the column 3 version, four have coefficients different from zero at the 1 percent significance level. Only RF and CDSUPPLY are not significant at the five percent level. Collinearity undoubtedly is a prime factor in the insignificance of the RF coefficients, the simple correlation coefficient between RF and TERM being 0.978. Also, one should recall that the large amount of noise in the short end of the Treasury bill yield curve has biased the coefficient of RF downward toward zero.

The coefficient of TERM indicates that each additional day to maturity increases yield 0.2 basis points. The yield differential between a three-month and a six-month CD would consequently be about 18 basis points, a plausible figure. How one should apportion this effect between default risk and liquidity preference cannot be precisely determined from the present analysis. We do note, however, that 0.2 basis points per day is an upper bound on the liquidity premium, assuming a linearly increasing premium over the range of observations (3 to 179 days). Indeed, one would expect that the default risk component of the term premium is quite small, implying that 0.2 basis points per day is approximately a least upper bound (bearing in mind that the results at best pertain only to December 30, 1977).

Each one percentage point increase in the ratio of liquid assets to CDs decreases required yield by about 0.2 basis points. While this effect may seem small, it is not inconsiderable. The difference between the maximum and minimum sample values of ASSET LIQ is about 140 percent, which implies a yield differential of 28 basis points. Large commercial banks typically earn between 50 and 100 basis points on total assets. A difference of 28 basis points in the cost of CD funds is thus quite significant for profit performance.

The negative coefficient for FOREIGN indicates that banks with more extensive overseas operations are able to raise funds in the domestic CD market at lower cost. The effects of foreign diversification of assets and enhanced access to foreign sources of funds, possibly coupled with a

pure scale effect, swamp any increase in bank risk due to greater susceptibility to political instability. Unfortunately, these results cannot indicate which of diversification, access to funds, or size is the dominant factor producing lower required yields on CDs.

Column 3' of table 1 shows regression results when the coefficient of RF is constrained to unity, as is customarily done in debt valuation models. The most striking alteration is the sign and absolute value of the coefficient of TERM, now negative and highly significant, which is counter-intuitive. On the other hand, the adjusted R-square is considerably higher, although the standard error of estimate increases by about 50 percent.[10] On grounds of economic sensibility, we conclude that the unconstrained estimates of column 3 are preferable.

Table 2 presents regression results for the model of column 3 when the sample is subdivided between banks with assets less than $25 billion and those with assets over $25 billion (90 observations in the former, 55 in the latter subsample). The intent of this subdivision is twofold. First, the CDSUPPLY and FOREIGN variables are strongly influenced by bank size, and subdividing the sample may help mitigate such scale effects. Second, banks whose assets exceed $25 billion may reasonable be expected to be what is referred to as the "top tier" of all banks issuing CDs. If CD markets really are tiered strictly by asset size of the issuing bank, such an effect should show up through this subdivision.

Apart from the intercept terms, the only variable which is statistically significant for the large class is TERM, while RF, ASSET LIQ,

CDSUPPLY, and FOREIGN are all significant at the 5 percent level or better for the small group. One can readily see that several parameter estimates appear to differ widely between the two groups; for example, the coefficient of RF is positive and significant for small banks though negative and insignificant for large, while CDSUPPLY is negative and significant for small and positive but insignificant for large. Despite these apparent differences, the familiar Chow test [4] [10] indicates that one cannot reject the null hypothesis that parameter estimates are the same for both classes ($F = 1.361$, with 6 and 133 degrees of freedom).[11] Entering slope dummy variables for the large class confirms this result in that no slope dummy variable is statistically different from zero at the 5 percent level of confidence, nor is an intercept dummy variable significant. On the basis of this evidence, we conclude that the hypothesis that CD markets are tiered solely on the basis of bank size must be rejected. Naturally, this conclusion does not preclude tiering of CD markets based upon more than a single criterion. Indeed, our results indicate that approximate risk classes of CD issuers can be predicated upon asset liquidity, foreign exposure, and perhaps also size.

Finally, some rather tenuous inferences can be drawn concerning the effect of bank size on CDSUPPLY and FOREIGN. CDSUPPLY is negative and significant for small banks but positive and insignificant for large banks. These results are consistent with the inferences that CDSUPPLY essentially proxies for size, that the yield-reducing effects of size are exhausted by the time the bank reaches $25 billion in total assets,

and that no large banks in the present sample had issued a larger quantity of CDs than the market thought normal as of December 31, 1977. It thus seems fair to conclude that evidence from CD markets does not support the relative supply effects that Fair and Malkiel discovered using aggregate data.

The comingled effects of diversification, access to funds, and size are harder yet to disentangle in the case of the FOREIGN variable. If one admits that the effect of size is exhausted at $25 billion in assets and that the effect of access to foreign sources of funds is probably also of no greater consequence to banks over this size, then the results for FOREIGN probably indicate diminishing returns to overseas diversification. This inference is supported by noting that the significance of FOREIGN's coefficient declines from small to large banks and by the fact that the sample ranges of values for FOREIGN are 3 percent to 37 percent for small banks and 33 percent to 58 percent for large banks. Obviously, we do not wish to overstate our confidence in these inferences.

V. Summary and Conclusions

This paper is a further contribution to the literature examining the extent to which financial markets respond to differences in bank riskiness when pricing bank liabilities. Unlike most previous efforts, we have focused on a market for short-term liabilities, large negotiable certificates of deposit. With many participants on both the demand and supply sides, the CD market is quite efficient relative to long-term debt markets (in which many issues are placed privately and consequently have no secondary market prices). Being fixed-income securities, CDs

obey a risk-differential model that has been widely employed in previous econometric work. To model CD yield behavior at the micro level, this study has used a novel source of data, annual reports published by large money market mutual funds. Since these funds invest hundreds of millions of dollars of assets each, they can be considered among the most sophisticated investors observable.

Because certificates of deposit are short-term instruments, the most relevant aspect of bank soundness is also short-term in nature. Liquidity thus assumes great importance in the empirical model, where leverage would typically be of more consequence in a long-term debt model. The flow of operating income from a bank's assets was found not to be a significant determinant of rates paid on CDs, however, nor were loan loss rates or leverage. Other factors influencing CD rates are the level of Treasury bill rates, the slope of the term structure, and the extent of foreign involvement by the bank. Results in this paper indicate that investors perceive banks with larger foreign claims to be less risky and/or to have easier access to foreign sources of funds, both effects lowering the cost of liabilities in domestic markets. To our knowledge, these are the first empirical estimates of the effect of foreign operations on bank risk from an investor point of view.

The results of this paper are important from a policy standpoint. The finding that risk characteristics of banks affect the terms on which they can issue money market instruments gives strong support to the suggestion that financial markets be allowed more responsibility for monitoring bank soundness [21]. While similar findings have been

reported in studies dealing with long-term debt, the infrequency with which banks place capital notes or debentures means that markets are rarely afforded the opportunity to exercise their control. Large CDs, however, are issued almost continuously by all large commercial banks and afford financial markets an ongoing ability to police bank risk-taking.

Table 1

Regression Results for CD Yield Model

	(1)	(2)	(3)	(3')
Intercept	5.996***	5.944***	5.968***	1.139***
	(16.077)	(16.840)	(17.105)	(33.900)
RF	0.120*	0.124*	0.121*	1.000
	(1.878)	(1.944)	(1.908)	
TERM	0.002***	0.002***	0.002***	- 0.007***
	(2.719)	(2.673)	(2.750)	(33.878)
ASSETS/CAP	- 0.003			
	(0.839)			
ASSET LIQ	- 0.001***	- 0.001***	- 0.002***	- 0.002**
	(2.778)	(3.389)	(3.520)	(2.542)
EARN/ASSETS	0.002			
	(0.276)			
LOAN LOSS	0.044	0.027		
	(0.710)	(0.522)		
CDSUPPLY	- 0.006	- 0.008	- 0.008	- 0.019**
	(1.127)	(1.600)	(1.525)	(2.381)
FOREIGN	- 0.002***	- 0.002***	- 0.002***	- 0.002
	(3.292)	(3.641)	(3.671)	(1.507)
$\bar{R}^2$	0.792	0.792	0.793	0.895
SEE	0.078	0.078	0.078	0.120
F	69.320	92.365	111.366	309.168

Notes: RF and EARN/ASSETS are interest rates expressed in percentage points; TERM is number of days; ASSET LIQ, LOAN LOSS, CDSUPPLY and FOREIGN are expressed in percentage points; $\bar{R}^2$ is adjusted for degrees of freedom; and SEE is the standard error of estimate expressed in percentage points of yield. Absolute values of T statistics are in parentheses. Significance levels are based on two-tailed tests and are denoted as follows: * = 10% level of type I error, ** = 5%, and *** = 1 %.

REFERENCES

[1] Beighley, H. Prescott. "The Risk Perceptions of Bank Holding Company Debtholders," Journal of Bank Research, Vol. 8 No. 2 (Summer 1977), pp. 85-93.

[2] Beighley, H. Prescott; Boyd, John H.; and Jacobs, Donald P. "Bank Equities and Investor Risk Perceptions: Some Entailments for Capital Adequacy Regulation," Journal of Bank Research, Vol. 6 No. 3 (Autumn 1975), pp. 190-201.

[3] Bradshaw, Robert C. "Foreign Exchange Operations of U.S. Banks," Proceedings of a Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, 1975, pp. 113-123.

[4] Chow, Gregory C. "Tests of Equality between Sets of Coefficients in Two Linear Regressions," Econometrica Vol. 28 No. 3 (July 1960), pp. 591-605.

[5] Cohan, Sandra B. "The Determinants of Supply and Demand for Certificates of Deposit," Journal of Money, Credit and Banking, Vol. 5 No. 1 Part I (February 1973), pp. 100-112.

[6] Cook, Timothy Q. and Hendershott, Patric H. "The Impact of Taxes, Risk and Relative Security Supplies on Interest Rate Differentials," Journal of Finance, Vol. 33 No. 4 (September 1978), pp. 1173-1186.

[7] Crane, Dwight B. "A Study of Interest Rate Spreads in the 1974 CD Market," Journal of Bank Research, Vol. 7 No. 3 (Autumn 1976), pp. 213-224.

[8] Crosse, Howard D. and Hempel, George H. Management Policies for Commercial Banks, second edition. Englewood Cliffs: Prentice-Hall, 1973.

[9] Fair, Ray C. and Malkiel, Burton G. "The Determination of Yield Differentials between Debt Instruments of the Same Maturity," Journal of Money, Credit and Banking, Vol. 3 No. 4 (November 1971), pp. 733-749.

[10] Fisher, Franklin M. "Tests of Equality between Sets of Coefficients in Two Linear Regressions," Econometrica Vol. 38 No. 2 (March 1970), pp. 361-366.

[11] Fisher, Lawrence. "Determinants of Risk Premiums on Corporate Bonds," Journal of Political Economy, Vol. 67 No. 3 (June 1959), pp. 217-237.

[12] Frankel, Allen. "The Lender of Last Resort Facility in an International Context," Proceedings of a Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, 1975, pp. 185-194.

[13] Henning, Charles N.; Pigott, William; and Scott, Robert Haney. Financial Markets and the Economy. Englewood Cliffs: Prentice-Hall, 1975.

[14] Instruments of the Money Market, edited by Timothy Q. Cook. Federal Reserve Bank of Richmond, 1977.

[15] Lintner, John. "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets," Review of Economics and Statistics, Vol. 47 No. 1 (February 1965), pp. 13-37.

[16] Malkiel, Burton Gordon. The Term Structure of Interest Rates: Expectations and Behavior Patterns. Princeton: Princeton University Press, 1966.

[17] Martin, Michael J. "Risk Premiums and Bank Bond Investors," Atlantic Economic Journal, Vol. 5 No. 2 (July 1977), pp. 68-72.

[18] Melton, William C. "The Market for Large Negotiable CDs," Quarterly Review, Federal Reserve Bank of New York, Vol. 2 No. 4 (Winter 1977-78), pp. 22-34.

[19] Mossin, Jan. "Equilibrium in a Capital Asset Market," Econometrica, Vol. 34 No. 4 (October 1966), pp. 768-783.

[20] Pettway, Richard H. "Market Tests of Capital Adequacy of Large Commercial Banks," Journal of Finance, Vol. 31 No. 3 (June 1976), pp. 865-875.

[21] Pettway, Richard H. "Capital Adequacy of Commercial Banks: A Question of Balance," Compendium of Major Issues in Bank Regulation. Washington, D.C.: U.S. Government Pricing Office, May 1973, pp. 512-521.

[22] Pinsky, Neil J. "Implications of International Operations of U.S. Banks for the Management of the Discount Window," unpublished manuscript, Federal Reserve Bank of Chicago, October 1978.

[23] Rolnick, Arthur J. "Modeling the CD Market: Hypotheses and Tests," Journal of Monetary Economics (forthcoming).

[24] Ruckdeschel, Fred B. "Risk in Foreign and Domestic Lending Activities of U.S. Banks," Proceedings of a Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, 1975, pp. 104-112.

[25] Sharpe, William F. "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk," Journal of Finance, Vol. 19 No. 3 (September 1964), pp. 425-442.

[26] Thomson, Thomas D.; Pierce, James L.; and Parry, Robert T. "A Monthly Money Market Model," Journal of Money, Credit and Banking, Vol. 7 No. 4 (November 1975), pp. 411-431.

[27] Weaver, Anne S. and Herzig-Marx, Chayim. "A Comparative Study of the Effect of Leverage on Risk Premiums for Debt Issues of Banks and Bank Holding Companies," Staff Memoranda 78-1, Federal Reserve Bank of Chicago.

Table 2

Regression Results for Subdivided Sample

	All	Small	Large
Intercept	5.968***	5.713***	7.057***
	(17.105)	(12.601)	(11.883)
RF	0.121*	0.170**	- 0.087
	(1.908)	(2.066)	(0.820)
TERM	0.002***	0.001	0.004***
	(2.750)	(1.547)	(3.576)
ASSET LIQ	- 0.002***	- 0.002***	- 0.001
	(3.520)	(3.112)	(1.103)
CDSUPPLY	- 0.008	- 0.021**	0.005
	(1.525)	(2.114)	(0.676)
FOREIGN	- 0.002***	- 0.002**	- 0.002*
	(3.671)	(2.314)	(1.847)
$\bar{R}^2$	0.793	0.782	0.789
SEE	0.078	0.082	0.069
F	111.366	65.788	42.346

Notes: See Table 1.

FOOTNOTES

*The authors are economists with the Federal Reserve Bank of Chicago. The views expressed are our own and not necessarily those of the Federal Reserve System. We wish to express thanks to Donald D. Hester, Elijah Brewer, and Harvey Rosenblum for helpful discussions and especially to Randall C. Merris for reading several drafts of this paper and helping us to clarify our thoughts.

[1]Textbooks on money and capital markets, such as [13], and other standard references, such as [14], typically state that commercial banks carry the highest credit ratings and that their liabilities are very nearly free of default risk. Indeed, bank liabilities are not usually differentiated from Treasury securities as regards default probability.

[2]Marketability of an issue, measured by the amount outstanding, is frequently included as an explanatory variable in debt models. In this study, such a variable is excluded because our sample displayed so little variation, the average CD being $6 million, with a standard deviation of $3 million and a range from $2 million to $15 million. That the first $40,000 of any CD is insured by the FDIC could also intrude into the analysis. Two percent of the face value of the smallest CD in this sample is insured, while only one-third of one percent of the largest is insured. Thus, considerations of marketability are likely to be confounded with insurance aspects of these deposits.

[3]Although somewhat dated in its empirical coverage, Malkiel [16] provides an excellent presentation of the theory of the term structure of interest rates.

[4]Several other asset and liability categories on the Report of Condition contain funds of maturities comparable to CDs or short-term Governments. For example, loans to domestic commercial banks include some term federal funds transactions, but also include some true term loans (i.e., longer than one year). Loans to banks in foreign countries are extremely volatile, tending to imply a short maturity, but little is known about the assets included in this category. Loans to other depository institutions contain a mixture of long and short maturities, as do loans to other financial institutions (largely credit to finance companies). All such balance sheet categories were excluded from the liquidity variable because the quality of the information is seriously in doubt.

[5]Crane [7] believes that investor concern over loan losses developed in the mid 1970s, but his data and methodology are inadequate to test that hypothesis.

[6]Cook and Hendershott [6], on the other hand, present evidence that most of what Fair and Malkiel observed was due to failure to take adequate account of tax effects and call provisions. Being time deposits, CDs are of course not influenced at all by call provisions, and tax effects can be expected to be relatively minor, since the average maturity in the sample is 99 days and very few CDs are issued with original terms in excess of six months.

[7]The universe of outstanding CDs for these purposes is taken to be total CDs issued by the weekly reporting banks. This figure will closely approximate the true universe of outstanding CDs.

[8]Most of the literature on foreign operations of U.S. banks has come out of the Federal Reserve System and has been oriented toward the implications of overseas activities for monetary policy. See [3], [12], and [22] for three aspects of this problem.

[9]Two possible explanations for this disparity come immediately to mind, namely, that either CD markets are not nearly so efficient as we believe them to be or that there is a significant segmentation of the CD market along regional/national lines. The smaller mutual funds are observed to invest more heavily in regional bank issues than the larger funds, which tend to restrict their purchases to money center banks. Investigating these two hypotheses should prove to be an interesting avenue of inquiry.

[10]The larger standard error of estimate is due to the fact that (3') was estimated in risk differential form (RCD - RF), rate spreads having larger variances than rate levels. One might also note that, from regression (3), the null hypothesis that the coefficient of RF equals unity can be safely rejected ($t = 13.952$).

[11]Results of the Chow test with the constrained form of the model are essentially the same and consequently are not reported.