

# The market for retail certificates of deposit: Explaining interest rates

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## Abstract

Retail certificates of deposit provide financial institutions with funds and depositors with income. Because interest rates and terms on deposits vary, understanding the reasons for the variation should help participants in this market make better decisions. This study explores interest rates and terms on deposit offerings from banks and thrifts while controlling for risk, service, and demographics. Results suggest that less than perfect market efficiency exists to the extent that institutions paying lower interest rates without offering other benefits may still obtain deposits, and depositors may improve returns and receive other benefits by comparing rates. © 2008 Academy of Financial Services. All rights reserved.

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## 1. Introduction

Banks and thrifts hold over a trillion dollars in retail certificates of deposit.<sup>1</sup> These deposits fund loans from which banks and thrifts earn income to pay interest to depositors. Therefore, bank and thrift managers should be familiar with the level of market efficiency to understand the importance of matching competitor terms, and depositors should be familiar with the level of market efficiency to understand the importance of comparing offers. Previous studies examine market efficiency by explaining interest rates with a few contract terms, but this is possibly the first study to use the early withdrawal penalty term. This study

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also attempts to explain interest rates with the minimum balance and maturity of the deposit, whereas controlling for risk and service level of the institution offering the deposit. In addition, the type of institution that offers the deposit, whether bank or thrift, is a potential influence on interest rates, as well as demographic influences from different metropolitan areas. The extent of market efficiency in this study depends on the amount of explainable variation in certificate of deposit interest rates. The results do not support a high level of market efficiency, although results do suggest that bank and thrift managers can vary interest rates on their certificates without chasing away depositors. Consequently, depositors should choose a deposit only after comparing several different offers, and should include those from thrifts in their comparisons.

The paper continues with a review of the literature on certificates of deposit, presents a methodology to study them, discusses the data for analysis, describes the results, and ends with some concluding remarks.

## **2. Literature**

When Regulation Q set interest rate ceilings, interest rates on certificates of deposit moved in tandem as a single supply price, which is the perspective in Cohan (1971) and Cohan (1973). However, a study of interest rates as a single supply price is not appropriate today, because interest rates on certificates of deposit now vary substantially across financial institutions and geographic markets. Data in the present study show that a range as wide as 500 basis points exists for interest rates from different institutions on a certificate of deposit with the same maturity. This significant range in basis points suggests a need for new research.

After Regulation Q ceilings disappeared, researchers began to examine individual certificate of deposit interest rates. Hannan and Hanweck (1988) find that the demand deposits to total assets ratio and a unit-banking variable explain jumbo certificate of deposit interest rates. Although the unit-banking variable is now obsolete, the demand deposits to total assets ratio may still be useful as a control variable for the extent of service in retail operations. In another approach, Berger and Hannan (1989) use economic data from different bank markets to explain individual certificate of deposit interest rates, but find no variable consistently significant. Similarly, Calem and Carlino (1991) use economic data from different bank markets to explain individual certificate of deposit interest rates, and find new households and region of the country significant, suggesting that demographic influence is important.

Cooperman, Lee and Lesage (1991) examine the spread between certificates of deposit and Treasury security yields in major metropolitan markets using panel data to find that local markets become more efficient over time, but that an efficient national market does not exist. Cooperman, Lee and Wolfe (1992) examine the impact of risk on certificate of deposit interest rates by exploring the influence of the 1985 Ohio deposit insurance crisis. They find that large banks and thrifts outside of Ohio, and banks and thrifts with substantial capital inside Ohio, did not change their certificate of deposit interest rates. However, they do find that banks and thrifts with low capital to asset ratios raised their interest rates by about 20 basis points at the time of the crisis, and that rates returned to normal within a few months.

This suggests that the risk of the offering institution may be important in explaining their interest rates. Hymel (1994) uses panel data on certificate of deposit interest rates from major banks in different states to find a market neither highly efficient nor highly inefficient. Surprisingly, he finds the market for retail certificates of deposit more efficient than the market for jumbo certificates. Gilkeson, Porter and Smith (2000) study jumbo certificates of deposit and focus on the early withdrawal penalty as a valuable option to the depositor. They find that the option has value, especially as yields on Treasury securities increase, since Treasuries are a substitute for certificates of deposit, and the option allows the depositor to force redemption, a feature absent in Treasury securities. However, their data do not include early withdrawal penalties for individual offerings.

Cvsa, Degeratu and Ott-Wadhawan (2002) discuss a survey on how bank customers respond to interest rate changes on certificates of deposit. The survey reports that only one-third of customers shop for interest rates at renewal time, and only 5% of customers switch banks. The survey also reports that most of the decision to choose a bank does not involve an interest rate consideration. This suggests that depositors substitute greater service for a higher interest rate, or that their lack of shopping creates a less than perfect market.

Cline and Brooks (2004) compare enhanced certificate of deposit interest rates to traditional rates. The enhanced certificates of deposit offer three extra options to the depositor beyond the traditional put option: the option to add deposits; the option to withdraw any amount penalty-free once; and the option to adjust the rate of interest once to a current market rate. Although these extra options provide additional benefits to customers and justify a lower interest rate, interest rates on enhanced certificates are similar to traditional certificates, and sometimes the enhanced certificate interest rates exceed the traditional rates. This also suggests that many depositors want other benefits besides high interest rates, or that many are simply not comparing contract offers.

In another study, Edwards and Swidler (2005) examine equity-linked certificates of deposit, finding them to have returns and volatility similar to Treasury securities. They fail to see why anyone would purchase such a deposit, other than for convenience, which further suggests that service is a major consideration to depositors, or that few compare offers. This study explores this issue by explaining interest rates with both contract terms and other influences to discover the extent of explainable interest rate variation, and at the same time tests for the extent of market efficiency.

### **3. Methodology**

If an efficient market for retail certificates of deposit exists, interest rates should be higher from thrifts than from banks, because thrifts have special privileges from Federal Home Loan Bank membership and the Internal Revenue Service tax code.<sup>2</sup> Other influences on interest rates are contract terms such as higher deposit minimums, greater early withdrawal penalties, and longer maturities. These terms are costs to depositors that justify additional compensation in the form of a higher interest rate. However, longer maturities may not have a strong positive association to interest rates because data for this study come from a time of a relatively flat U.S. Treasury yield curve. Nonetheless, the positive expectation remains in the

model to allow for the possibility that banks and thrifts set their own normal yield curve for certificate of deposit interest rates. Control variables are necessary for risk, service, and demography. Institutions with higher risk sometimes offer higher interest rates as in Cooperman, Lee and Wolfe (1992), when the measure for risk is the capital to asset ratio of the institution. Although retail customers may not demand higher interest rates from riskier institutions, riskier institutions may offer higher interest rates to attract additional deposits and invest those funds in additional risky assets, which might then correspond with lower capital to asset ratios. Institutions may substitute service for a high interest rate, so the ratio of demand deposits to total assets controls for service level, consistent with Hannan and Hanweck (1988), and Edwards and Swidler (2005). Therefore, the higher the ratio of demand deposits to total assets, the more likely a financial institution provides a higher service level through branches and personnel, but because branches and personnel are costly, these institutions may offer lower interest rates. The demographic impact on interest rates should appear by using binary variables to represent each metropolitan area, consistent with Calem and Carlino (1991). The binary variables require the arbitrary removal of one metropolitan area from the analysis to serve as a base for comparison, and this study removes New York. The signs on these variables depend on demographic factors such as growth in new housing units of a particular area in comparison to New York, so these signs may vary. In summary, the null and alternative hypotheses are as follows:

Null hypothesis: Contract terms do not explain certificate of deposit interest rates.

Alternative hypothesis: Contract terms do explain certificate of deposit interest rates.

The theoretical relationships appear in Eq. (1):

$$(+) \quad (+) \quad (+) \quad (+) \quad (-) \quad (-) \quad (+/-)$$

$$Rate_{ijk} = f(Thrift_j, Minimum_{ijk}, Penalty_{ijk}, Maturity_{ijk}, Capital_j, Demand_j, Area_k) \quad (1)$$

Where:

$Rate_{ijk}$  is the interest rate on the  $i^{th}$  certificate of deposit from the  $j^{th}$  institution in the  $k^{th}$  metropolitan area;

$Thrift_j$  is a binary variable coded one if the  $j^{th}$  institution is a thrift and zero if a bank;

$Minimum_{ijk}$  is the minimum amount necessary to open the  $i^{th}$  certificate of deposit from the  $j^{th}$  institution in the  $k^{th}$  metropolitan area;

$Penalty_{ijk}$  is the percentage of the minimum amount ( $Minimum_{ijk}$ ) paid as a penalty on the  $i^{th}$  certificate of deposit from the  $j^{th}$  institution in the  $k^{th}$  metropolitan area if funds are withdrawn immediately after opening;

$Maturity_{ijk}$  is the time in months necessary to avoid an early withdrawal penalty on the  $i^{th}$  certificate of deposit from the  $j^{th}$  institution in the  $k^{th}$  metropolitan area;

$Capital_j$  is the capital to asset ratio of the  $j^{th}$  institution offering the certificate of deposit;

$Demand_j$  is the demand deposits to assets ratio of the  $j^{th}$  institution offering the certificate of Deposit; and

$Area_k = 2, \dots, k$  is a binary variable for the  $k^{th}$  metropolitan area where  $k = 1$  is New York,  $k = 2$  is Los Angeles,  $k = 3$  is Dallas,  $k = 4$  is Boston,  $k = 5$  is San Francisco,  $k = 6$

is Houston,  $k = 7$  is Chicago,  $k = 8$  is Detroit,  $k = 9$  is Philadelphia, and  $k = 10$  is Washington DC. The New York metropolitan area serves as a comparison base.

#### 4. Data

The data for this study are from a Bankrate.com survey and Federal Deposit Insurance Corporation (FDIC) Call and Income reports. The Bankrate.com survey has data on certificates of deposit from banks and thrifts in the largest metropolitan areas of the United States. The certificates of deposit are from five banks and five thrifts with the most deposits in each metropolitan area. Data were collected between November 29 and December 4, 2006 and were on the Bankrate.com Website in March of 2007. Data for each certificate of deposit include the interest rate, the minimum deposit, the early withdrawal penalty, and the time to maturity. The time to maturity is 3, 6, 12, 30, or 60 months. Some institutions did not offer every maturity. The FDIC data are from its Website at [www.fdic.gov](http://www.fdic.gov) and allow identification of the financial institution as a bank or thrift, and the calculation of the capital to assets and demand deposits to assets ratios as of September 30, 2006. That date allows the FDIC data to have been available to the public at the time of the survey. Data summaries of descriptive statistics appear in Panel A and Panel B of Table 1, and include means, standard deviations, minimums, maximums, and number of observations for each variable. Panel A has statistics for both types of institutions as a single group, and Panel B has separate statistics for banks as a group and thrifts as another group. Pearson correlations between all variables except the metropolitan area binaries are in Table 2.

The descriptive statistics in Panel A of Table 1 for *Rate* show that interest rates on all certificates of deposit in the sample range from 0.45% to 5.45%. This range also occurs within the 3-month maturity subsample. The other maturity subsamples have similar ranges. *Thrift* statistics show its binary coding, which is zero for a bank and one for a thrift. *Minimum* statistics show that minimum deposits in the overall sample range from \$100 to \$10,000, and that approximate range exists for every maturity subsample. *Penalty* statistics show that penalties for early withdrawal range from 0.04% to 12.5% of the minimum deposit, but this broad range applies mainly to the 60-month subsample, since other subsamples have narrower ranges. *Maturity* statistics show that maturities on the certificates of deposit appropriately range from 3 to 60 months. *Capital* statistics show that capital to assets ratios of the institutions offering the certificates of deposit range from 0.05 to 38%. *Demand* statistics show that demand deposits to assets ratios of the institutions range from zero to 65.1%. *Area* statistics begin with New York and show that means are not identical because some institutions do not offer certificates of deposit in every maturity category. Each mean reflects the portion of all certificates of deposit available in a particular metropolitan area. Additional evidence of some institutions not offering all maturities is in the number of certificates of deposit in the study. If 10 institutions in each metropolitan area offer all five maturities, then each metropolitan area would have 50 certificates of deposit available, and with 10 metropolitan areas, the total would be 500. However, because some institutions do not offer every maturity, the certificates of deposit total 481. Standard deviations for the

Table 1

Panel A descriptive statistics on data from certificates of deposit and the financial institutions offering the certificates in 2006

Variable	Mean	SD	Minimum	Maximum	N
<i>Rate</i>	3.62%	1.13	0.45%	5.45%	481
3-month	2.87%	1.22	0.45%	5.45%	97
6-month	3.58%	1.21	0.45%	5.3%	99
12-month	3.80%	1.07	0.5%	5.4%	99
30-month	3.80%	0.89	0.5%	5.1%	89
60-month	4.06%	0.83	0.5%	5.35%	97
<i>Thrift</i>	0.50	0.50	0	1	481
<i>Minimum</i>	\$1,511	1,869	\$100	\$10,000	481
3-month	\$1,618	1,943	\$250	\$10,000	97
6-month	\$1,464	\$1,726	\$250	\$10,000	99
12-month	\$1,319	\$1,496	\$100	\$10,000	99
30-month	\$1,354	\$1,564	\$100	\$10,000	89
60-month	\$1,793	\$2,443	\$250	\$10,000	97
<i>Penalty</i>	1.78%	1.64	0.04%	12.5%	481
3-month	0.68%	0.66	0.04%	3.5%	97
6-month	1.07%	0.75	0.09%	3.5%	99
12-month	1.75%	1.16	0.24%	5.5	99
30-month	2.38%	1.37	0.25%	6.2%	89
60-month	3.07%	2.35	0.25%	12.5%	97
<i>Maturity</i>	21.96 months	21.21	3 months	60 months	481
<i>Capital</i>	6.32%	6.88	0.05%	38.0%	481
<i>Demand</i>	3.44%	9.35	0	65.1%	481
<i>Area</i> <sub>1</sub> (New York)	0.10	0.31	0	1	481
<i>Area</i> <sub>2</sub> (Los Angeles)	0.10	0.30	0	1	481
<i>Area</i> <sub>3</sub> (Dallas)	0.10	0.30	0	1	481
<i>Area</i> <sub>4</sub> (Boston)	0.10	0.30	0	1	481
<i>Area</i> <sub>5</sub> (San Francisco)	0.10	0.29	0	1	481
<i>Area</i> <sub>6</sub> (Houston)	0.10	0.31	0	1	481
<i>Area</i> <sub>7</sub> (Chicago)	0.10	0.31	0	1	481
<i>Area</i> <sub>8</sub> (Detroit)	0.09	0.28	0	1	481
<i>Area</i> <sub>9</sub> (Philadelphia)	0.10	0.30	0	1	481
<i>Area</i> <sub>10</sub> (Washington DC)	0.10	0.30	0	1	481

*Note.* *Rate* is the annual percentage interest rate paid on the deposit. *Thrift* is a binary variable coded 1 for a thrift institution, otherwise 0. *Minimum* is the minimum deposit. *Penalty* is the percentage of *Minimum* paid as a penalty for early withdrawal of the deposit. *Maturity* is months to maturity of the deposit. *Capital* is the capital to assets ratio and *Demand* is the demand deposits to assets ratio, both in percentage for the institution offering the deposit. *Area* is 1 for the metropolitan area where the certificate of deposit offer was available, otherwise it is 0.

metropolitan area variables have a similar explanation, and those variables have the correct coding because minimums are zero and maximums are one.

Comparing means of variables by type of financial institution, whether bank or thrift, provides insight as to whether or not two different markets exist. Variable means by institution type, whether bank or thrift, appear in Panel B of Table 1. *Rate* means show that the mean interest rate on certificates of deposit from banks is 3.24%, and from thrifts is 4.01%. *Minimum* means show that the mean minimum deposit from banks is \$1,668, and from thrifts is only \$1,354. However, the *Penalty* means show that the mean penalty for early

Table 1  
Panel B descriptive statistics on data from certificates of deposit and the financial institutions offering the certificates in 2006 by type of financial institution

Variable	Type of institution	Mean	SD	Minimum	Maximum	N
<i>Rate</i>	Bank	3.24%*	1.05	0.45	5.15	241
	Thrift	4.01%*	1.08	0.51	5.45	240
<i>Minimum</i>	Bank	\$1,668	1,743	350	10,000	241
	Thrift	\$1,354	1,979	100	10,000	240
<i>Penalty</i>	Bank	1.59%*	1.43	0.04	8.63	241
	Thrift	1.96%*	1.81	0.04	12.50	240
<i>Maturity</i>	Bank	22.07 months	21.29	3	60	241
	Thrift	21.85 months	21.18	3	60	240
<i>Capital</i>	Bank	6.24%	5.60	0.06	22.08	241
	Thrift	6.39%	7.97	0.05	37.99	240
<i>Demand</i>	Bank	2.88%	2.70	0.00	11.27	241
	Thrift	4.00%	12.94	0.00	65.12	240
<i>Area</i> <sub>1</sub> (New York)	Bank	0.10	0.31	0	1	241
	Thrift	0.10	0.31	0	1	240
<i>Area</i> <sub>2</sub> (Los Angeles)	Bank	0.10	0.31	0	1	241
	Thrift	0.10	0.30	0	1	240
<i>Area</i> <sub>3</sub> (Dallas)	Bank	0.10	0.31	0	1	241
	Thrift	0.10	0.30	0	1	240
<i>Area</i> <sub>4</sub> (Boston)	Bank	0.10	0.30	0	1	241
	Thrift	0.10	0.31	0	1	240
<i>Area</i> <sub>5</sub> (San Francisco)	Bank	0.10	0.31	0	1	241
	Thrift	0.09	0.28	0	1	240
<i>Area</i> <sub>6</sub> (Houston)	Bank	0.10	0.31	0	1	241
	Thrift	0.10	0.31	0	1	240
<i>Area</i> <sub>7</sub> (Chicago)	Bank	0.10	0.31	0	1	241
	Thrift	0.10	0.31	0	1	240
<i>Area</i> <sub>8</sub> (Detroit)	Bank	0.08	0.28	0	1	241
	Thrift	0.09	0.29	0	1	240
<i>Area</i> <sub>9</sub> (Philadelphia)	Bank	0.10	0.30	0	1	241
	Thrift	0.10	0.31	0	1	240
<i>Area</i> <sub>10</sub> (Washington DC)	Bank	0.10	0.29	0	1	241
	Thrift	0.10	0.30	0	1	240

*Note.* *Rate* is the annual percentage interest rate paid on the deposit. *Thrift* is a binary variable coded 1 for a thrift institution, otherwise 0. *Minimum* is the minimum deposit. *Penalty* is the percentage of *Minimum* paid as a penalty for early withdrawal of the deposit. *Maturity* is months to maturity of the deposit. *Capital* is the capital to assets ratio and *Demand* is the demand deposits to assets ratio, both in percentage for the institution offering the deposit. *Area* is 1 for each metropolitan area where the certificate of deposit offer was available, otherwise it is 0. The asterisk (\*) indicates significance at the 0.01 level in a one-way ANOVA means test comparing the bank mean to the thrift mean.

withdrawal from banks is just 1.59%, while the mean from thrifts is 1.96%. *Maturity* means show that maturities on certificates of deposit from banks and thrifts are similar because of the symmetry in the sampling. *Capital* means show that the mean capital to assets ratio for banks is 6.24%, and for thrifts is 6.39%. *Demand* means show that the mean of the demand deposits to assets ratio for banks is 2.88%, and for thrifts is 4.00%. *Area* means for each of the metropolitan area variables indicate that a similar distribution of banks and thrifts exists

Table 2

Correlations for data from certificates of deposit and the financial institutions offering the certificates in 2006

	<i>Rate</i>	<i>Thrift</i>	<i>Minimum</i>	<i>Penalty</i>	<i>Maturity</i>	<i>Capital</i>	<i>Demand</i>
<i>Rate</i>	1.00						
<i>Thrift</i>	.341*	1.00					
<i>Minimum</i>	.126*	−.084	1.00				
<i>Penalty</i>	.417*	.111*	.025	1.00			
<i>Maturity</i>	.263*	−.005	.052	.503*	1.00		
<i>Capital</i>	−.043	.011	−.097	.009	−.003	1.00	
<i>Demand</i>	.079	.060	−.096	−.041	.003	.203*	1.00
<i>Area</i> <sub>1</sub> (New York)	−.101	.001	−.117*	−.045	.004	.137*	.000
<i>Area</i> <sub>2</sub> (Los Angeles)	.015	−.006	.050	−.125*	.001	.112	.239*
<i>Area</i> <sub>3</sub> (Dallas)	.007	−.006	.035	.036	.001	.251*	−.003
<i>Area</i> <sub>4</sub> (Boston)	−.122*	.008	−.121*	−.083	.001	.217*	.033
<i>Area</i> <sub>5</sub> (San Francisco)	−.088	.028	−.005	−.119*	−.018	.136*	.219*
<i>Area</i> <sub>6</sub> (Houston)	.036	.001	.007	.045	.004	.316*	−.012
<i>Area</i> <sub>7</sub> (Chicago)	.094	.001	.191*	.142*	.004	−.308*	−.124*
<i>Area</i> <sub>8</sub> (Detroit)	.164*	.015	.124*	.083	.005	−.279*	−.112
<i>Area</i> <sub>9</sub> (Philadelphia)	−.094	.008	−.103	−.023	.001	−.305*	−.123*
<i>Area</i> <sub>10</sub> (Washington DC)	.098	.008	−.056	.092	−.004	−.299*	−.120*

*Note.* *Rate* is the annual percentage interest rate paid on the deposit. *Thrift* is a binary variable coded 1 for a thrift institution, otherwise 0. *Minimum* is the minimum deposit. *Penalty* is the percentage of *Minimum* paid as a penalty for early withdrawal of the deposit. *Maturity* is months to maturity of the deposit. *Capital* is the capital to assets ratio and *Demand* is the demand deposits to assets ratio, both in percentage for the institution offering the deposit. *Area* is 1 for the metropolitan area where the certificate of deposit offer was available, otherwise it is 0. Correlations between *Area* variables not shown are appropriately 1 or near 0. The asterisk (\*) indicates significance at the 0.01 level using a two-tailed test.

within each metropolitan area. Panel B of Table 1 also shows pairs of bank and thrift means with an asterisk that are significantly different from each other at the 0.01 level using a one-way ANOVA means test. The two variables with significantly different bank and thrift means are *Rate* and *Penalty*. The ANOVA test suggests that although rates tend to be lower from banks than from thrifts, banks tend to charge lower penalties for early withdrawal of a deposit.

Variable correlations in Table 2 have an asterisk by those pairs significant at the 0.01 level for a two-tailed test. For example, *Rate* has significant positive correlation to *Thrift*, *Minimum*, *Penalty*, and *Maturity*. This suggests that interest rates on certificates of deposit are high when the institutions offering the deposits are thrifts, the deposit minimums are high, penalties for early withdrawal are big, and maturities of the deposit are long. However, the lack of significance between *Rate* and both *Capital* and *Demand* suggests that interest rates on certificates of deposit do not depend on the capital to assets or demand deposits to assets ratios of the institutions offering the deposits. The only significant correlations between *Rate* and the *Area* variables are when the metropolitan areas are Boston and Detroit, which suggest that low interest rate offers exist in Boston, but high interest rate offers exist in Detroit. The only significant correlation between *Thrift* and another variable is with *Penalty*, which suggests that thrifts charge a high penalty for early withdrawal of a deposit. The significant correlations for *Minimum* are with the New York, Boston, Chicago, and Detroit *Area* variables. These correlations suggest that certificate of deposit offers in New

Table 3  
Highest and lowest interest rates on certificates of deposit with the same maturity in different metropolitan areas from the same financial institution

Financial institution	3-month Lo-Hi	6-month Lo-Hi	12-month Lo-Hi	30-month Lo-Hi	60-month Lo-Hi
Bank of America	1.9–2.15	2.16–2.41	2.9–3.41	2.9–3.45	3.41–3.71
Chase Bank	2.75–3.5	3.75–4.0	4.0–4.0	3.75–3.75	3.75–3.75
Citibank	3.5–3.75	5.0–5.0	4.2–4.3	4.35–4.45	4.6–4.71
Comerica Bank	2.3–3.8	2.5–4.0	3.25–4.1	3.5–4.1	3.55–4.15
Wachovia Bank	2.4–2.5	2.75–2.9	3.25–3.25	3.35–3.6	3.75–4.0
Washington Mutual Bank	1.35–1.35	3.1–3.85	3.35–3.6	3.3–4.8	3.51–4.05
Wells Fargo Bank	0.89–2.0	1.55–2.75	1.65–3.25	2.6–3.4	2.6–3.6
World Savings Bank	3.06–3.42	4.09–4.51	4.67–4.72	4.4–4.61	4.56–4.87

*Note.* Each column to the right of the financial institution has months to maturity of the deposit. Below each maturity is the lowest and highest interest rate for offers from the same institution in different metropolitan areas. Washington Mutual Bank and World Savings Bank are thrifts and the other financial institutions are banks. Other terms may vary.

York and Boston have low minimum deposit requirements, yet offers in Chicago and Detroit have high minimums. *Penalty* and *Maturity* have a significant correlation that suggests penalties for early withdrawal are high with long contract maturities. *Penalty* also has significant negative correlation with the Los Angeles and San Francisco *Area* variables, and significant positive correlation with the Chicago *Area* variable. This suggests that low penalties exist for certificate of deposit offerings in Los Angeles and San Francisco, but high penalties exist in Chicago. *Maturity* has no additional significant correlation with any other variable. *Capital* and *Demand* have significant positive correlation, suggesting that capital to assets ratios are high when demand deposits to assets ratios are high. Both *Capital* and *Demand* have many significant correlations, both positive and negative, with *Area* variables, indicating that capital to assets ratios and demand deposits to assets ratios of the financial institutions often depend on the metropolitan area. Correlations between the *Area* variables are not in Table 2. While significant correlations between the variables make ordinary least square estimators less precise, the magnitude of the correlations suggest that serious multicollinearity problems are unlikely.

Table 3 lists financial institutions that offer certificates of deposit in more than one metropolitan area, but with different interest rates for the same maturity. For example, Bank of America offers certificates of deposit in eight metropolitan areas, with interest rates for 3-month maturities that range from 1.9% to 2.15%. Although Bank of America offers different interest rates in different metropolitan areas for the same maturity, sometimes interest rates for a particular maturity are the same in different metropolitan areas. Similarly, Comerica Bank, Wells Fargo Bank, and World Savings Bank all offer different interest rates in different metropolitan areas for every maturity. Chase Bank is different, because although it has a presence in five metropolitan areas, it has interest rates that vary only within 3- and 6-month maturities. The other maturities Chase offers have the same interest rates regardless of metropolitan area. Financial institutions with just one maturity that has the same interest rate in different metropolitan areas and four other maturities with different offers are

Citibank, Wachovia Bank, and Washington Mutual Bank. In addition to the financial institutions shown in Table 3 whose interest rates vary for the same maturity across metropolitan areas, the sample data also contain six institutions that offer certificates of deposit in several metropolitan areas with the same interest rate within each maturity.

## 5. Results

The ordinary least square regression results are in Table 4. The results are from regressing the *Rate* variable on the regressors as shown in Eq. (1), and including additional regressor interaction terms that are the products of *Thrift* and the other regressors. The interaction term coefficients measure the difference between banks and thrifts in the impact that a regressor has on the interest rate, holding constant the other regressors. An *F* test for overall joint significance of the coefficients on *Thrift* and all its interaction terms provides evidence that at least one nonzero coefficient exists at the 0.01 level.<sup>3</sup> Certificate of deposit offers from banks and thrifts provide 481 observations to estimate the coefficients of the ordinary least squares multiple regression model. A Cook's Distance test shows no outliers using 0.80 as the cutoff, in accordance with Kvanli, Pavur and Keeling (2003). The adjusted  $R^2$  reveals that the regressors explain over 41% of the variation in certificate of deposit interest rates. Almost half of the regressors are significant at the 0.01 level. The intercept is significant and suggests a base certificate of deposit interest rate of 2.94%. The *Thrift* coefficient is not significant and suggests that the base interest rate is the same for banks and thrifts, although this result is not surprising given that some influence of institution type also exists in the *Area* regressors.

The regressors that reflect the terms of the deposit contract are *Minimum*, *Penalty*, and *Maturity*. The *Minimum* coefficient measures the influence on interest rates of minimum deposits from banks, and the *ThriftMinimum* interaction term coefficient measures the influence on interest rates of minimum deposits from thrifts in comparison to banks. The *Minimum* coefficient is positive and significant according to its *t*-statistic, which is evidence that banks pay higher interest rates when they have higher minimum deposit requirements. The *ThriftMinimum* coefficient is also significant according to its *t*-statistic, but is negative, which indicates that thrift minimum deposit requirements affect deposit interest rates differently than bank requirements. The measure of the bank impact on deposit interest rates from minimum deposit requirements is simply the *Minimum* coefficient; however, the measure of the thrift impact on deposit interest rates from minimum deposit requirements is the sum of the *Minimum* and *ThriftMinimum* coefficients. The sum of the coefficients indicates that thrifts with higher minimum deposit requirements pay slightly lower interest rates.<sup>4</sup> The *Minimum* and *ThriftMinimum* coefficients are jointly significant according to the *F*-statistic, which is evidence that minimum deposit requirements influence deposit interest rates without regard to institution type.<sup>5</sup> The positive impact on interest rates of minimum deposits from banks is consistent with expectations, but the negative impact from thrifts is a surprise, with the only consolation being that the impact is small. The *Penalty* coefficient is positive and significant, but the *ThriftPenalty* coefficient is not significant. This is evidence that higher penalties for early withdrawal correspond with higher deposit interest rates, but

Table 4  
OLS Estimators explaining certificate of deposit interest rates

Regressor	Coefficient	<i>t</i> Statistic	<i>F</i> Statistic
Constant	2.94	15.05*	n/a
<i>Thrift</i>	−.113	−0.31	n/a
<i>Minimum</i>	.020	5.58*	15.83*
<i>ThriftMinimum</i>	−.021	−4.401*	
<i>Penalty</i>	.230	4.66*	19.17*
<i>ThriftPenalty</i>	−.052	−.783	
<i>Maturity</i>	.010	3.50*	6.67*
<i>ThriftMaturity</i>	−.007	−1.51	
<i>Capital</i>	.039	1.71	1.67
<i>ThriftCapital</i>	−.033	−1.30	
<i>Demand</i>	−.186	−4.47*	13.75*
<i>ThriftDemand</i>	.199	4.75*	
<i>Area</i> <sub>2</sub> (Los Angeles)	−.141	−.532	8.33*
<i>ThriftArea</i> <sub>2</sub>	1.152	3.13*	
<i>Area</i> <sub>3</sub> (Dallas)	−.517	−2.08	8.33*
<i>ThriftArea</i> <sub>3</sub>	1.406	3.95*	
<i>Area</i> <sub>4</sub> (Boston)	−.368	−1.46	2.08*
<i>ThriftArea</i> <sub>4</sub>	.696	1.98	
<i>Area</i> <sub>5</sub> (San Francisco)	−.424	−1.69	3.75*
<i>ThriftArea</i> <sub>5</sub>	.989	2.71*	
<i>Area</i> <sub>6</sub> (Houston)	−.358	−1.42	2.08*
<i>ThriftArea</i> <sub>6</sub>	1.166	3.28*	
<i>Area</i> <sub>7</sub> (Chicago)	−.604	−1.77	2.08*
<i>ThriftArea</i> <sub>7</sub>	1.397	3.23*	
<i>Area</i> <sub>8</sub> (Detroit)	−.114	−.332	11.25*
<i>ThriftArea</i> <sub>8</sub>	1.410	3.18*	
<i>Area</i> <sub>9</sub> (Philadelphia)	−.263	−.781	0.42
<i>ThriftArea</i> <sub>9</sub>	.272	.637	
<i>Area</i> <sub>10</sub> (Washington DC)	−.487	−1.44	10.00*
<i>ThriftArea</i> <sub>10</sub>	1.679	3.80*	

*Note.* The dependent variable is *Rate*, the interest rate on the deposit. *Thrift* is a binary regressor coded 0 for a bank and 1 for a thrift, and is used as an interaction term when placed in front of other variables. *Minimum* is the minimum deposit in hundreds of dollars. *Penalty* is the percentage of *Minimum* paid as a penalty for early deposit withdrawal. *Maturity* is months to deposit maturity. *Capital* is the capital to assets ratio and *Demand* is the demand deposits to assets ratio, both in percentage for the institution offering the deposit. *Area*<sub>2,...,10</sub> are metropolitan areas with a value of 1 if the deposit is available there, otherwise 0. New York serves as the absent base category. The adjusted  $R^2$  is 0.413 using 481 observations. The maximum Cook's Distance is 0.037. An *F* test on *Thrift* and all interaction terms produces a test statistic of 11.17 that rejects joint insignificance of those regressors at the 0.01 level. The *t* statistic appears for each coefficient, and where applicable the *F* statistic appears to test joint significance. An asterisk indicates that the *t* or *F* statistic exceeds the critical value at the 0.01 level of significance.

that no substantial difference exists in this relationship between banks and thrifts. The test for joint significance provides evidence that the penalty for early withdrawal is useful to explain interest rates without regard to institution type. The positive association of the penalty for early withdrawal to the deposit interest rate is consistent with expectations. Similarly, the *Maturity* coefficient is positive and significant but the *ThriftMaturity* coefficient is not significant. This is evidence that longer maturities correspond with higher deposit interest rates, but that no difference exists in this relationship between banks and thrifts. The test for

joint significance provides evidence that the maturity of the deposit is useful to explain interest rates without regard to institution type.

The regressors that measure the impact on interest rates from the risk and service characteristics of the institution offering the deposit are *Capital* and *Demand*. The *Capital* and *ThriftCapital* coefficients are each not significant, and jointly not significant. These results suggest that the capital to assets ratio does not influence interest rates on certificates of deposit in the sample, either through banks, thrifts, or without regard to institution type. The lack of influence is no surprise, since the capital to assets ratio measures the risk that an institution might fail, but since a major financial crisis was probably absent at the time of data collection, and depositors had the benefit of deposit insurance, this influence should have little if any impact on deposit interest rates. The *Demand* and *ThriftDemand* coefficients are both significant, and the coefficients are jointly significant. The negative coefficient on *Demand* indicates that higher demand deposits to assets ratios in banks correspond with lower interest rates on their certificates of deposit. The positive coefficient on the *ThriftDemand* coefficient indicates that thrifts influence interest rates differently through the demand deposits to assets ratio than banks. The sum of both coefficients reflects the thrift service influence on interest rates, and that influence is slightly positive. A negative relationship between service and interest rates is consistent with expectations, so the bank result is consistent, but the slight positive relationship for thrifts is not consistent with expectations. The joint significance test for the *Demand* and *ThriftDemand* coefficients indicates that the demand deposits to assets ratio influences interest rates without regard to institution type.

The *Area* regressors measure demographic influences on certificate of deposit interest rates and include Los Angeles, Dallas, Boston, San Francisco, Houston, Chicago, Detroit, Philadelphia, and Washington DC. New York is absent to serve as a comparison base. The *Area<sub>2</sub>* coefficient is not significant, suggesting that banks in Los Angeles pay about the same interest rates as financial institutions in New York. However, the *ThriftArea<sub>2</sub>* interaction term coefficient is significant and positive, suggesting that Los Angeles thrifts pay higher interest rates on their deposits than Los Angeles banks. The test for joint significance of the *Area<sub>2</sub>* and *ThriftArea<sub>2</sub>* coefficients is evidence that the Los Angeles demographic influence is important in explaining certificate of deposit interest rates. The Los Angeles results are consistent with expectations. The results for the Los Angeles metropolitan area are essentially the same for the Dallas, San Francisco, Houston, Chicago, Detroit, and Washington DC areas. The results for Boston and its interaction term are different. The Boston coefficient is not significant, nor is the interaction term coefficient. However, the test for joint significance of those coefficients is significant, which implies that the Boston influence is important to explain interest rates, even though the individual coefficients are not separately significant. This situation could be because of high correlation between the Boston and its interaction term regressors, which results in large standard errors on the individual coefficients.<sup>6</sup> Results for the Philadelphia metropolitan area show no significance from any of the tests. The test results provide evidence that interest rates from banks in Philadelphia are similar to those from institutions in New York, banks and thrifts in Philadelphia pay about the same rates, and overall, the Philadelphia metropolitan area interest rates are no different from those in New York. The Boston and Philadelphia results are inconsistent with expectations, although

the majority of the *Area* regressor coefficients are consistent with expectations that thrifts offer higher interest rates than banks.

## 6. Conclusion

This study examines the market for retail certificates of deposit with a model that suggests interest rates on the certificates depend on the type of institution offering the certificate, the terms of the deposit contract, the risk and service orientation of the financial institution offering the deposit, and the metropolitan area where the financial institution offers the deposit. Results suggest a less than perfectly efficient market, because the model explains less than half of the variation in interest rates. However, results do suggest that thrifts tend to offer higher interest rates than banks; and banks tend to have higher rates along with higher minimums, higher penalties, higher maturities, and lower service. Of particular value is the discovery about the penalty for early withdrawal contract term, which explains interest rates but is absent from previous studies. Also noteworthy is the finding that the risk of the offering institution does not influence the interest rate, suggesting that other risk measures may be more appropriate, or that risk was not a concern for depositors.

This study is important for institutions that offer retail certificates of deposit and the depositors that accept those offers because it suggests that the certificate of deposit market is not highly efficient. Financial institutions may be able to pay lower interest rates, offer less favorable terms and service, and remain major market participants. Depositors cannot always rely on the level of the interest rate to reflect the terms of the contract. Although in general, higher interest rates appear with less favorable contract terms, this is not always true, since higher interest rates also appear with more favorable contract terms. In addition, depositors should not always assume that a higher rate coincides with less service, because results show that higher rates can come from institutions having a greater service orientation. Therefore, depositors need to check rates, terms, and service available from different institutions, and should even check within the same institution when it operates in more than one metropolitan area, since rates from the same institution can differ from one metropolitan area to another. Finally, the limitations of the study include the cross-sectional nature of the data, and the possibility that the model could need additional regressors. Additional research opportunities exist to determine if the findings are robust across time and different model specifications.

## Notes

1. From the Federal Deposit Insurance Corporation's *Statistics on Depository Institutions Report* for total time deposits, all institutions, as of June 30, 2007. Time deposits less than \$100,000 total \$1,031,049,551,000. Of that amount, \$302,421,342,000 is in maturities of up to three months; \$529,961,444,000 is in maturities of over three months up to 12 months; \$149,314,495,000 is in maturities of over one year to three years; and \$49,352,180,000 is in maturities of over three years. Subcategories sum to just under the total.

2. Federal Home Loan Bank membership provides low-cost funds to thrifts. Membership is also open to large commercial banks but they must hold at least 10% of assets in long-term mortgages. The tax differences between commercial banks and thrifts are set forth in Title 26 of the US Code, Subtitle A, Chapter 1, Subchapter H, where Part I has rules for banks and Part II has rules for thrifts.
3. The  $F$  test uses an unrestricted unadjusted  $R^2$  of 0.448, a restricted unadjusted  $R^2$  of 0.247, 30 coefficients for the unrestricted model, 15 coefficients for the restricted model, and 481 total observations to produce a test statistic of 11.17, which rejects the null hypothesis that all thrift regressors are equal to zero at the 0.01 level of significance.
4. Table 4 shows a coefficient of 0.020 for *Minimum* and -0.021 for *ThriftMinimum*. This says that for banks, a one hundred dollar increase in the minimum deposit requirement corresponds with a 0.020 higher annual percentage interest rate on the certificate of deposit. For thrifts, a 100-dollar increase in the minimum deposit requirement corresponds with a 0.001 lower annual percentage interest rate (0.020–0.021). *Minimum* is in hundreds of dollars so that the coefficients are visible within three decimals.
5. Stock and Watson (2007) explain interactions between regressors and the series of appropriate hypotheses tests on their pages 280–283.
6. Stock and Watson (2007) discuss a similar situation on their page 283.

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