Economic Review

Federal Reserve Bank of San Francisco

Spring 1990 Number 2

Bank Pricing of Retail Deposit Accounts and "The California Rate Mystery"

Jonathan A. Neuberger
and Gary C. Zimmerman

Economists, Federal Reserve Bank of San Francisco. We are grateful to the editorial committee, Carolyn Sherwood-Call, Frederick Furlong, and Elizabeth Laderman, for many helpful and constructive comments. We would like to thank Stephen Dean, Brantley Dettmer, and Stacey Dogan for excellent research assistance.

In this paper, we examine apparent interest rate discrepancies on retail deposit accounts between banks in California and those in the rest of the country. Some have suggested that California banks pay below-market rates on their deposits. We investigate these claims for both transaction accounts and certificates of deposit. We find that the discrepancies are primarily limited to transaction-based accounts. Using a microeconomic model of deposit interest rate setting, we show that the interest rate discrepancies can be partially explained by the unique characteristics of California bank markets and by different responses of California banks to interest rate determinants. However, a substantial portion of the interest rate differentials for transaction accounts persists even after accounting for these effects.

On several occasions during the past few years, the financial press and a number of consumer groups in California have suggested that there is a "deposit rate mystery" in the state, noting that California banks have been paying lower interest rates on deposit accounts and charging higher rates on loans than banks in other parts of the country. These groups have suggested that California banks have sufficient market power to pursue anticompetitive pricing policies. If such claims are true, then consumer welfare could be enhanced by policies that encourage greater competition and reduce market power in the California market for bank services.

Although these claims have provoked a heated debate on the nature of banking in California, they have not produced much rigorous analysis of the issue. Rigorous analysis is needed to establish first, whether statistically significant interest rate differentials between California and the rest of the country do, in fact, exist and second, what factors account for the differences in interest rates.

In this paper, we conduct such an analysis. In Section I we examine interest rates paid by banks in California and the rest of the U.S. and find that differentials do exist for at least some types of retail deposit accounts. We then consider the price-setting behavior of banks in Section II to determine why such differentials persist. Broadly speaking, there are two possible explanations. First, interest rate disparities may arise because the characteristics of bank markets in California differ from those in the rest of the country. Alternatively, California banks may respond to the determinants of deposit rates differently than their counterparts do elsewhere. In the final sections of this paper, we conduct an empirical analysis of bank price-setting behavior using explanatory factors suggested by economic theory. We employ a pooled time-series, cross-section data base of over 400 banks, including 29 California banking institutions, to estimate interest rate equations for four types of bank deposit accounts. Our analysis indicates that both explanations of the origins of the interest rate differentials are valid, and each helps to explain at least a portion of the observed interest rate discrepancies.

I. Is There a Rate Mystery?

In this section we look for evidence of a California deposit rate mystery. We examine interest rate differentials on four of the most popular retail deposit accounts in the U.S. As of December 30, 1987, these accounts had a combined total of $782.3 billion in deposits, comprising approximately 39 percent of total bank deposits nationally.

We consider two accounts with transaction features and two categories of small-denomination time certificates of deposit (CDs). The transaction accounts are Negotiable Order of Withdrawal (NOW) accounts (an interest-bearing, unlimited transaction checking account with $174.8 billion in deposits) and money market deposit accounts (MMDAs), a limited-checking transaction account with $353.8 billion in deposits.

The two retail CD accounts are both small denomination (less than $100,000). The first account includes CDs issued with three- to six-month original maturities. These accounts had $132.4 billion in deposits nationally as of December 30, 1987. The other account is a long-term CD, including deposits with original maturities of 2½ years or more and had $121.3 billion in deposits. These were the two most popular of the six retail time certificate maturity categories reported during the 1984-1987 period.

Charts 1 and 2 show the differences between average deposit interest rates paid by a sample of 435 banks nationwide during the 1984-1987 period and average rates paid on comparable accounts by the 29 California banks in the sample. The data are taken from Federal Reserve Board surveys of interest rates paid by banks on retail deposits.[1] These surveys provide the most common rate paid on retail accounts for each bank. Most common interest rates are adjusted for differences in compounding and then converted to basis points. As Chart 1 indicates, we observe a substantial differential between bank rates in the U.S. and those in California for both MMDAs and NOWs. The positive numbers graphed in the chart indicate that, on average, interest rates on both NOWs and MMDAs were lower in California than elsewhere. Over the two-year period ending in December 1987, the NOW differential averaged 37 basis points. The average differential for MMDAs measured 28 basis points over the 1984-87 period. Both differences are statistically significant at the five percent level.[2] At no time during this period did average rates on these deposits in California exceed the national average. Moreover, the rates in major California markets were below the average for several other major markets, including New York, Chicago, Philadelphia, and Boston. This direct interest rate comparison confirms that the California rate mystery has indeed existed for both NOW accounts and MMDAs.[3]

Chart 1
MMDA and NOW Accounts
Rate Differentials: U.S - California

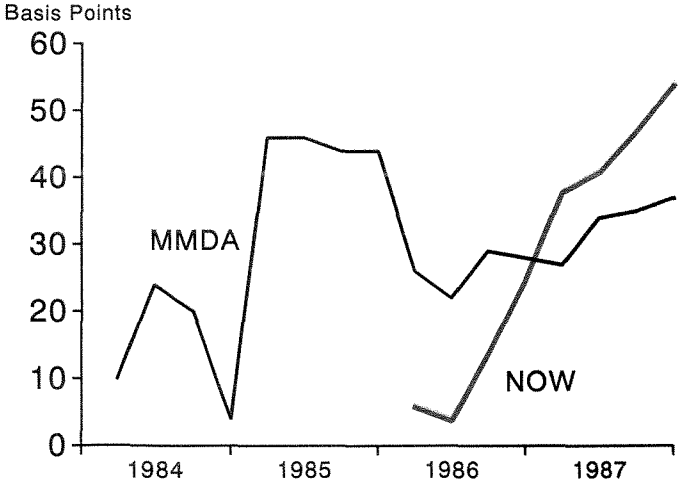
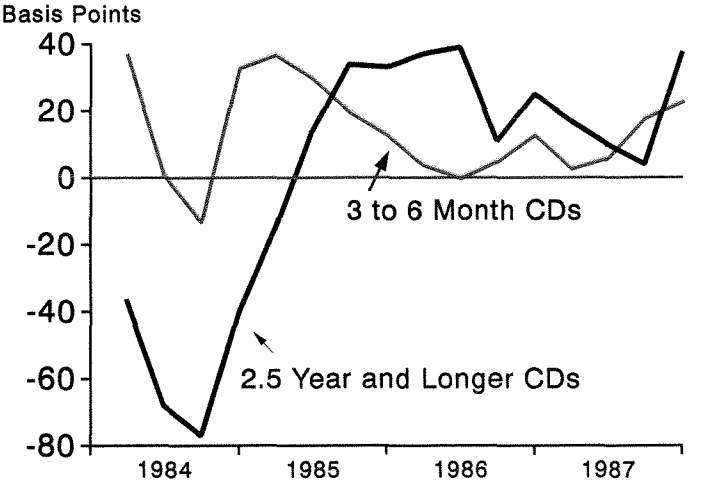


Chart 2
3 to 6 Month and 2.5 Year and Longer CDs
Rate Differentials: U.S. - California



The evidence for the two retail CD accounts, presented in Chart 2, is less dramatic, with considerably smaller interest rate differentials. The three- to six-month CDs averaged 20 basis points lower in California over the 1984-1987 period, while the 2½ year and over CDs averaged only 11 basis points less in California. During the early part of the sample period, rates on the long-term CDs in California regularly exceeded the U.S. average. In both instances, the observed differentials are not statistically significant at the five percent level. There is thus less clear-cut evidence that a persistent rate differential has existed for the two CD accounts.

II. Determinants of Retail Deposit Interest Rates

Our comparison of retail deposit pricing in the U.S. and California indicates that banks in California have priced some, but perhaps not all, of their retail deposits differently than banks in other states. To determine whether these disparities arise because the characteristics of bank markets in California are different from those elsewhere or because California banks respond differently to interest rate determinants, we consider a model of bank deposit pricing that takes into account many of the factors that may influence interest rates on bank deposits. If variation in these factors explains the observed interest rate differentials, then it is the unique characteristics of bank markets in California that give rise to the disparities in rates. On the other hand, if these influences cannot account for the disparities in rates, then California banks must be responding to these influences differently than their counterparts do elsewhere.

For purposes of modelling bank deposit pricing, we can envision a bank as a "financial factory," combining inputs via a production technology to yield a set of outputs. The bank's outputs are the various lending, intermediary, and transaction services it provides. The bank's inputs are its deposits. When a depositor puts funds in a bank account, the bank can use these funds to make loans or other investments. In return, the depositor receives a direct payment for providing the input, namely interest, as well as the ability to consume some of the bank's outputs, namely bank services associated with the deposit account (in this way, bank deposits play a dual role in this model). These services are a form of "implicit interest" received by depositors.

It is essential to incorporate the service aspects of bank deposits into the analysis since such services may be a significant component of the total return to depositors. Explicit interest rates, by themselves, may not adequately measure this total return. We can treat the direct price the bank pays for its inputs (that is, the interest rates it pays on its deposits) like any other input price. Assuming the bank acts to maximize profits, it is possible to determine the price of the input as a function of output prices (that is, the value of bank services, such as transaction services or convenience), relevant characteristics of the production technology, and the price of near-substitutes (in this case, a market interest rate). This simple microeconomic framework suggests a number of variables that should help to explain the interest rates that banks pay on deposits. Thus, in general terms, we can model deposit interest rates as

$$r = f(x) \tag{1}$$

where r is the interest rate paid by a bank on a particular deposit account, x is a vector consisting of variables like measures of bank costs of providing services to depositors, measures of the availability of bank services, market interest rates, etc., and $f(.)$ is a functional form that links deposit rates to the variables in vector x.

One issue that arises in modeling deposit rates is the relevant structure of bank deposit markets. Banks that enjoy some degree of market power as purchasers of deposit funds may be able to exercise this market power by acting as price setters rather than price takers in deposit markets. If evidence of bank market power does exist, this would lend credence to the complaints of California consumer groups regarding bank behavior in the state. Equation (1), therefore, may need to be modified in the following way:

$$r = f(x, MP) \tag{2}$$

where MP is a variable that measures market power in the relevant deposit market.

This formulation suggests that empirical analysis of deposit rates should include some measure of market power. Following the market structure-performance framework from the economics of industrial organization, a number of studies of bank behavior have used measures of market structure as proxies for market power. According to this framework, there is a positive relationship between market concentration and firm profitability. This is due to the hypothesis that a high degree of market concentration endows firms with significant market power and makes it easier for them to collude or engage in other forms of non-competitive behavior.

There is an extensive literature on the empirical relation-

ship between measures of market structure, on the one hand, and bank profits and prices, on the other. In these studies, measures of market concentration, such as *n*-firm concentration ratios or the Herfindahl-Hirschman Index (HHI), and/or market share statistics are used as proxies for market power. Although many of these studies have identified a positive relationship between market concentration and bank profitability, the results vary considerably as to the size of the estimated effect. In addition, a number of studies have failed to identify such a relationship between market structure and bank performance. The findings from this research thus are not conclusive.[4]

Demsetz (1973), Peltzman (1977), and others have offered an alternative interpretation of the positive relationship between structure and profits. According to this "efficient structure" hypothesis, particular industries may exhibit firm-specific efficiencies that lead naturally to relatively concentrated markets. These efficiencies enable leading firms in such markets to capture large market shares and to enjoy higher profits than less efficient firms in less concentrated settings. In effect, concentration is the result of the operational efficiency of firms rather than an exogenous characteristic of the market that firms exploit.[5] One important implication of this hypothesis for bank markets is that efficient banks in concentrated markets offer rates on deposits that are *more* favorable to depositors. This prediction contrasts with the structure-performance framework described above.

In a recent study, Berger and Hannan (1989) develop an empirical framework that enables them to differentiate between the structure-performance hypothesis and the efficient structure hypothesis. Both of these models imply a positive relationship between market concentration and bank profitability. They suggest opposite effects of concentration on *prices*, however. Berger and Hannan investigate the relationship between bank prices (that is, interest rates on retail deposit account products) and measures of market concentration using a cross section of individual banks in the U.S. They find a statistically significant negative relationship between interest rates on money market deposit accounts and market concentration. This means that bank customers face less favorable rates on MMDAs in markets that are more concentrated. This finding supports the structure-performance hypothesis and rejects the efficient structure hypothesis.

In contrast to their findings regarding MMDAs, Berger and Hannan find no evidence of any price-concentration relationship for several categories of certificates of deposit. They argue that such instruments are traded in broader geographic markets that are less likely to be influenced by local market conditions. One implication of these findings is that bank pricing strategies differ across account types. Alternatively, banks may not have the same market power for all retail deposit products. Berger and Hannan find no evidence to support the efficient structure hypothesis.

Another important factor that may affect the structure of bank markets is the regulatory environment in which banks operate. A number of bank regulations, such as state branching restrictions or unit banking laws, limit the geographic scope of bank markets. Just as market power can act as a hindrance to competitive behavior, regulatory restrictions can erect barriers to entry that shield banks from the influence of unrestricted competition. Any characterization of bank market structure should thus include the effects of bank regulations as well as measures of market power.

The microeconomic framework discussed above predicts that a number of explanatory variables should be included in a properly specified interest rate equation. A bank-specific model, developed by Hannan (1989), provides some guidance about likely candidates to include in empirical interest rate equations. For purposes of the current study, we divide these factors into three general categories: measures of market conditions, indicators of state-specific regulatory restrictions on banking, and cost and balance sheet data on individual banks. This last group of variables acts as proxies for service levels provided by banks and controls for other relevant effects.

Measures of Market Conditions

One issue that arises in deriving measures of market conditions is the proper definition of the relevant market in which the bank operates. Some bank deposits can be considered primarily local products, for example, accounts with transaction features. Since local checks are easier to cash, and clear faster than out-of-town checks, local providers of transaction accounts have a competitive advantage over out-of-town providers. Competition for transaction accounts therefore may be geographically limited by the need to provide local check-clearing services.[6] In contrast, certificates of deposit are pure savings vehicles that may trade in broader geographic markets. As a result of this ambiguity regarding the appropriate market definition, we provide measures of both local and statewide market conditions in order to capture influences of the varying geographic scope of bank markets.

As a measure of market power, we use local market three-firm concentration ratios, with local markets defined as Metropolitan Statistical Areas (MSAs) and non-MSA

counties. As an additional measure of local market conditions, we include the growth rate of deposits in these markets. We expect that higher deposit growth rates reflect greater demand for bank deposits by banks. If this is true, higher growth rates will be associated with higher deposit interest rates and we thus predict a positive coefficient on this explanatory variable. We also recognize, however, that the influence of deposit growth rates on deposit interest rates could represent supply effects in the market for bank deposits, implying a different relationship between these variables. Even though this variable could reflect both demand and supply conditions in the market for bank deposits, we believe it is important to include it in the regression equations in this paper. One reason is that California bank markets exhibited among the slowest deposit growth rates in the sample. This variation from the rest of the sample should be included in the empirical analysis. There are also a number of precedents for this variable in deposit interest rate studies, such as Berger and Hannan (1989) and Keeley and Zimmerman (1985).

At the state level, we include a number of variables that capture important aspects of the broader geographic market for bank services. One of these variables is the total per capita bank offices in the state. This measure controls for differences across states in the relative availability of bank offices. One interpretation of this variable is that it represents the level of competition in the state banking market. If more bank offices per capita mean greater competition, then this variable may be associated with more favorable interest rates for bank depositors. The expected sign of the estimated coefficient on this variable would then be positive. Alternatively, more banking offices in a state may increase banks' ability to deliver services on a per capita basis. This variable may proxy, therefore, for convenience and service differentials that exist at state levels. In this case, the estimated coefficient should be negative.

As a measure of general market conditions, our regressions include the money market mutual fund rate as a proxy for the "market" interest rate. The money market fund rate varies over time with other market interest rates and captures the return to a near-substitute for many bank deposits. Banks must compete with money market funds in order to continue attracting deposits.[7] We expect that there is a very strong positive correlation between the money market fund rate and the rates paid on retail deposits that serve as savings vehicles since these accounts are close substitutes. The relationship between transaction account rates and money fund rates is not likely to be as strong. Transaction services are an essential component of these accounts. They are therefore less obvious substitutes for money market mutual funds.

Measures of State-Specific Restrictions on Banking

Our regressions measure state-level regulatory restrictions on banking and bank branching. We include dummy variables for states that have limited branching and unit banking laws. Limited branching laws represent a regulatory barrier to entry into local markets within a state. Such barriers are likely to restrict the degree of competition across local banking markets. Within their designated markets, banks in limited branching states may offer services that are roughly comparable to those of banks in states that allow unlimited branching. The primary difference between banks in limited and statewide branching states may therefore be this regulatory barrier to entry. We expect that the effect of limited branching on deposit interest rates is negative.

Likewise, banks in states with unit banking laws face regulatory barriers to entry. Thus, the relationship between unit banking laws and deposit rates should be negative. However, banks in unit-banking states cannot offer the same kinds of services that banks in unlimited (or even limited) branching states can. In effect, unit banks are forbidden from competing for deposits in many of the nonprice dimensions, such as offering more convenience through a branch network. Banks in these states essentially are forced to compete primarily through the explicit interest rates on their deposit accounts. This will have a positive effect on deposit rates. Thus, the estimated coefficient on the unit banking dummy could be either positive or negative, depending on which influence dominates.

Cost and Balance Sheet Measures of Individual Banks

The last group of explanatory variables contains factors specific to individual banks. This group includes variables intended to capture service and convenience aspects of bank deposit accounts. Some of these variables, such as the number of bank branches, attempt to measure implicit interest on bank accounts directly, while others infer the value of implicit interest from measures of the costs that arise from providing these services.

The first factor, then, is the number of bank branches.[8] This variable may help to capture the service and convenience components of an individual bank's products. Banks may offset a lower explicit interest rate on certain kinds of deposits with the convenience and service of an extensive branch network. As a result, we would expect to observe a negative relationship between deposit rates and the number of branches.

The branches variable has several limitations. It is not a useful proxy for bank-specific implicit interest payments

in the eight states that had unit banking laws during the sample period. It also may not fully capture the service dimension of bank deposits. For example, longer hours and additional days open, ATMs, free or underpriced services, and promotions are not captured by the number of branches. But since these factors do entail higher operating costs, we include two cost variables as proxies: overhead (non-interest) expenses per dollar of assets and average bank salaries (total payroll expenses including benefits divided by the number of employees). Assuming that banks are profit maximizers, differences in overhead expenses and average salaries across banks should reflect either differences in the level of services provided (and, therefore, differences in implicit interest), or differences between high- and low-cost areas. To the extent that differences in operating costs reflect differences in implicit interest, we would predict a negative correlation between deposit rates and overhead expenses and salaries. Banks that offer higher compensation in the form of implicit interest may pay less explicit interest, with the net result that total compensation to the depositor is unchanged.

The bank-specific variables also include an asset-based measure of bank size as a control variable. Aside from the part size plays in determining market concentration measures, a bank's size may be important if depositors use it as an indicator of an institution's health and staying power, or its financial resources. This study includes a full range of banks, from money center institutions to small, single-office banks. Larger banks may have a wider range of alternatives to retail deposits than small institutions. Thus, at the margin, it is likely that bank size exhibits a negative influence on deposit rates.

Finally, we include a measure of the portfolio composition of each bank, as measured by the ratio of retail time deposits to total deposits. In general, the markets for large-denomination, wholesale CDs are more competitive than retail deposit markets. Banks that rely more heavily on retail core deposits, therefore, may be able to tap cheaper funding sources. The effect of this variable on deposit rates is thus likely to be negative.

By incorporating all of the above influences into an empirical pricing model of retail deposits, we hope to capture the key determinants of retail deposit rates. In this way, we can determine whether it is the unique characteristics of California banking markets that explain the deposit rate mystery.

III. Empirical Results: The Rate Mystery Thickens

Our discussion in the previous section describes a model of bank behavior and suggests a number of factors that should influence the interest rates paid on bank deposits. These include the local market concentration ratio as well as a number of other market, regulatory, and bank-specific cost factors. We estimate a version of this model on a time-series, cross-section sample of approximately 430 banks during the 1984-1987 period. With 16 quarterly values for each bank, we have almost 7,000 observations in our sample.[9]

These data suggest that California bank markets differ from markets elsewhere in a number of important respects. As Table 1 shows, California alone accounts for ten percent of U.S. bank deposits. In terms of the average asset size of the banks in our sample, California ranks second, at $6.8 billion, after New York. The sample average is only $2.6 billion in assets. California ranks third in terms of the number of branches per bank, at 121, well above the sample average of only 40 branches. Despite the large branch systems designed to attract retail deposits, California banks rank relatively low in the proportion of retail time deposits to total deposits. Moreover, California banks were among the slowest growing banks during the 1984 through 1987 period.[10] Indeed, in terms of the growth rate of local market deposits over this period, California banks ranked 47th out of the 48 states and District of Columbia included in our data sample.

California banks not only grew more slowly, they also incurred higher costs than the average. California ranked fourth highest in terms of average salary costs per employee and second in terms of overhead expenses per dollar of assets. The high costs may reflect additional expenses associated with staffing and operating the large retail branch systems common in the state. They may also be due to higher land and labor costs in California. Alternatively, these higher costs may reflect inefficiencies associated with a lack of competition arising from geographic barriers or monopoly power.

While California banks display some unique characteristics, a notable exception is the level of market concentration. Our measure of concentration is the three-firm deposit concentration ratio for the local market. This is defined as the combined market share of deposits held by the three largest banks in the market, divided by total bank deposits in the market. In terms of a weighted average state 3-firm concentration ratio (where local markets are weighted by deposit shares), California ranks near the middle, 25th out of 48 states and the District of

Columbia. It would appear at first glance that concentration alone cannot explain the lower deposit interest rates paid by California banks.[11]

These observations suggest that differences between bank markets in California and those elsewhere may help to explain deposit rate disparities. To test this hypothesis, we estimate the following equation:

$$r_{ijt} = a + b_1 CR3_{jt} + b_2 x_{ijt} + b_3 y_{ijt} + b_4 z_{ijt} + cCA_i + e_{ijt} \quad (3)$$

where r_{ijt} is the interest rate paid on one type of retail account by bank i in local market j at time period t. $CR3_{jt}$ is the 3-firm concentration ratio in local market j at time t, x_{ijt} is a vector of the market-specific variables included in the model, y_{ijt} represents a vector of the regulatory variables that may be important for bank i's pricing decisions in market j, z_{ijt} is a vector of bank-specific variables relevant to deposit pricing, CA_i is a dummy variable for banks located in California, and e_{ijt} is the error term. The parameters a and c and the vectors b_1 through b_4 are coefficients to be estimated.

Table 1

Average Sample Characteristics of U.S. vs. California Banks and Bank Markets

	U.S.	California	CA Rank
Total Deposits of Insured Commercial Banks (as of 12/31/87; $ billions)	$2,324	$231	2
3-Firm Concentration Ratio (wtd. avg. of local markets in state)	53.9%	63.2%	25
Market Deposit Growth Rate (wtd. avg. of local markets)	9.2%	2.5%	47
Per Capita Bank Offices in State	2.5	2.0	48
Average Bank Assets ($ millions)	$2,627	$6,811	2
Number of Branches per Bank	40	121	3
Retail Time Deposits as % of Total Deposits	55.1%	48.9%	43
Overhead Expenses per Dollar of Assets (cents)	2.1	2.9	2
Average Salary per Employee ($ thousands)	$15.6	$18.1	4

We estimate the model for the full sample of banks over the entire sample period for each deposit category. If the California dummy variable is statistically significant, then there are differences in interest rates between banks in California and those elsewhere that cannot be attributed merely to differences between the characteristics of bank markets in California and those elsewhere. Rather, a statistically significant coefficient on this dummy variable suggests that the explanation for the California deposit rate mystery lies elsewhere.

In Table 2, we present regression results for the four categories of deposits included in this study.[12] The first two columns contain the regression results for the two transactions-oriented accounts: NOWs and MMDAs. As described above, NOWs are interest-bearing checking accounts with transaction features that tie them predominantly to local bank markets. MMDAs provide a combination of features, including limited transactions and short-term market rate savings services designed to make them competitive with money market mutual fund shares. The transaction features may also tie MMDAs to local bank markets to some extent, as well.

Looking first at columns (1) and (2), we observe that local market concentration exerts a significant effect on deposit interest rates for both NOWs and MMDAs. These results suggest that local market power (as measured by the concentration ratio) is associated with lower deposit interest rates for these transaction-based accounts. The estimated coefficients are of similar magnitude, and predict that a 10-percentage point increase in market concentration (say, from 50 percent of deposits controlled by the top three firms in the local market to 60 percent) reduces deposit rates 1.3 to 1.7 basis points on MMDAs and NOWs, respectively.[13,14]

Several other factors are also significant in determining the deposit interest rates on these two accounts. The estimated coefficients on local market deposit growth rates are positive and significant in both regressions. These estimates imply that this variable captures demand factors in the local market, as we hypothesized above. Bank assets also are positively correlated with deposit interest rates, indicating that larger banks tend to pay higher rates. The limited branching dummy variable has the expected negative sign, suggesting that state branching restrictions do indeed represent market barriers to entry. Unit banking laws, in contrast, appear to exert an upward influence on deposit rates. This finding suggests that such laws force banks to compete through the explicit interest rates they pay on retail deposits. The more transactions-oriented NOW accounts are only loosely related to market interest rates, as indicated by the 0.26 coefficient on the money

market fund rate. The more savings-oriented MMDAs follow market interest rates more closely, with an estimated coefficient of 0.83.

It is noteworthy that a number of the variables that proxy for implicit interest payments also are significant in these two regressions. The estimated coefficients on the number of bank branches are significant and negative for both transaction accounts. In addition, the average salary variable also displays a significantly negative coefficient. This term represents some of the costs associated with maintaining branches and providing implicit interest. Overhead expenses per dollar of assets are not significant in these two regressions.

The final explanatory variable included in these regressions is the dummy variable for California banks. The results described here indicate that our interest rate model has suggested a number of variables that are important determinants of deposit interest rates. On top of these determinants, however, we observe significant coefficients for the California dummy variable. Thus, rates paid by California banks on NOWs and MMDAs differ from the rest of the banks in the sample in a way that cannot be explained by the model. This means that, after taking account of the effects of the explanatory variables included in the model, deposit rates on these two accounts were consistently lower in California by an average of 26 basis points for NOWs during the 1986-87 sample period and by 19 basis points for MMDAs from 1984 to 1987. In view of the average differentials observed in Chart 1 of 37 and 28 basis points for NOWs and MMDAs, respectively, these

Table 2

Deposit Rate Regressions, 1984–1987

	Dependent Variable (rate in basis points)			
Independent Variable	(1) NOW (1986–87)	(2) MMDA	(3) 3–6 mo. CD	(4) 2.5 yr. CD
Constant	390.97**	101.06**	70.45**	169.75**
	(44.82)	(16.73)	(10.08)	(17.42)
3-Firm Concentration Ratio	−17.20**	−13.26**	−8.93*	−11.55
	(−4.54)	(−3.45)	(−2.00)	(−1.90)
Market Deposit Growth Rate	22.48**	16.97**	17.93**	35.61**
	(4.48)	(3.37)	(3.14)	(4.55)
Per Capita Bank Offices in State	0.60	8.27**	2.18	−0.33
	(0.49)	(6.48)	(1.47)	(−0.16)
Bank Assets	0.81**	0.74**	1.06**	0.66**
	(5.28)	(4.67)	(5.70)	(2.48)
Number of Branches	−0.10**	−0.06**	−0.09**	−0.01
	(−8.23)	(−4.92)	(−6.34)	(−0.57)
Retail Time as % of Total Deposits	−0.07	−0.46**	−0.18**	−0.05
	(−1.49)	(−9.68)	(−3.37)	(−0.71)
Overhead Expenses per $ Assets	−0.77	−1.25	−3.37**	−3.42**
	(−1.22)	(−1.87)	(−4.29)	(−3.05)
Average Salary	−0.84**	−1.79**	−1.39**	−1.15**
	(−7.78)	(−15.35)	(−10.28)	(−5.90)
Limited Branching Dummy	−6.62**	−3.73*	−7.00**	−5.18*
	(−4.50)	(−2.46)	(−3.97)	(−2.14)
Unit Banking Dummy	5.33*	19.88**	0.93	−3.02
	(2.28)	(8.62)	(0.35)	(−0.81)
Money Market Mutual Fund Rate	0.26**	0.83**	1.00**	1.00**
	(22.82)	(196.10)	(202.77)	(146.50)
California Dummy	−25.67**	−19.39**	−7.73*	−1.72
	(−8.20)	(−6.05)	(−2.11)	(−0.33)
R-Bar Squared	0.243	0.866	0.869	0.780
No. of Observations	3415	6573	6637	6475

Notes: *(**) indicates coefficient significantly different from zero at the 5 (1) percent level; t-statistics in parentheses.

coefficients suggest that variations in the model's explanatory variables account for approximately one-third of the observed differentials on both NOWs and MMDAs.

As a final observation on these regressions, we note that the deposit rate model performs considerably better in explaining the variation in MMDA rates than it does for NOW account rates. The R-bar squared statistic is .866 for the MMDA regression, and only .243 for NOWs. We thus explain only about one quarter of the variation in NOW rates. In fact, NOW account interest rates move infrequently while the explanatory variables exhibit considerable variation during the sample period. Our deposit rate model clearly does not capture the reasons for the sluggish movement in NOW rates, as reflected by the low explanatory power of this regression.

The last two columns of Table 2 contain comparable regression results for the two categories of retail certificates of deposit. Looking first at the estimated coefficients on the concentration ratio, we find that the estimates are negative, but are smaller and less statistically significant than for the two transaction accounts. The coefficient on the three-firm concentration ratio is significant at the five percent level for the short-term CD, although the absolute value of the point estimate is substantially smaller than for either transaction account. The estimated coefficient on market concentration is not significantly different from zero for the long-term certificate. The relationship between local market concentration and deposit interest rates for these CDs is thus less important than it is for the two transaction accounts.[15]

One explanation for this finding is that these retail certificates of deposit are more strictly savings vehicles and, the longer the certificate, the less important local bank services are likely to be to the depositor. Therefore, markets for these CDs may encompass a much broader geographic scope. Moreover, CD rates are frequently published and made available on a regional or national basis, allowing funds to be deposited outside the local market area by mail or through deposit brokers. At the margin, competition may serve to minimize differentials across markets. As a result, CD rates are less likely to be affected by local market conditions and, thus, we would expect to observe a smaller effect of local market concentration on the interest rates on CDs than on transaction accounts.

The regression results for the two CDs also differ from those for NOWs and MMDAs in other ways, for example, with respect to the significance of the variables that measure implicit interest. Aside from average salaries, which have a negative impact on all four rates, we find that short-term CDs appear to have some degree of a service component, as indicated by the significant negative coefficient on the number of branches. The long-term certificate is the only account category of the four for which this variable is not statistically significant. Overhead expenses also appear to exert some downward pressure on CD rates, in contrast to a lack of any observed effect on transaction accounts. This finding is difficult to explain, especially if we believe that these non-interest expenses measure the cost of providing implicit interest.[16]

The dummy variable for unit banking states has no statistically significant effect on deposit rates for either CD category, in contrast to the positive estimated coefficients for the two transaction accounts. Although unit banking laws appear to induce banks to compete primarily on the basis of interest rates for transaction accounts, these laws have no such identifiable effect for certificates. This result is consistent with the notion that CDs trade in geographic markets that are not confined by state borders. In the market for strict savings vehicles, one bank may look like any other, regardless of its ability to offer branches.

Finally, we expect that both of these savings certificates should follow market interest rates closely to maintain their attractiveness relative to competing instruments. The estimated results confirm this prediction, as shown by the 1.0 estimated coefficients on the money market fund rate.

The estimated coefficients on the California dummy variable also indicate some important differences between transaction accounts and certificates of deposit. While the point estimates for these dummy variable coefficients are negative for both account maturities, the California dummy variable is not statistically significant for long-term CDs and is significant only at the five percent level for the short-term certificates. The latter results suggest that, after taking other factors into account, short-term CD rates were eight basis points less in California than elsewhere during the 1984-1987 sample period. This is substantially smaller than the observed differentials for the transaction accounts.[17] For the long-term CDs, rates in California are statistically indistinguishable from those paid by banks in other states.[18,19]

IV. Explaining the Mystery

The estimated coefficients on the California dummy variables in Table 2 provide evidence that, although standard determinants of bank deposit rates help to explain a portion of the disparity in rates between California and the U.S., a sizable proportion of this disparity apparently is the result of other factors. Specifically, with respect to NOWs and MMDAs, California banks may respond differently to the factors included in our model than do banks elsewhere.[20] There is less evidence, however, that different pricing strategies prevail for the two certificates of deposit. Given these findings, we focus in the remainder of this paper on explaining the sources of the interest rate differentials for NOWs and MMDAs only.

One way to interpret the significant California dummy coefficients for the transaction accounts is that they indicate an inappropriate restriction on the estimated model. The full-sample regressions impose the restriction that the estimated coefficients for all banks (regardless of location) are identical. If California banks respond differently to the determinants of deposit interest rates than banks elsewhere, then this restriction is incorrect. F-statistics constructed from separate regressions for the California and non-California banks in our sample support the notion that California banks respond differently to interest rate determinants than banks elsewhere. These tests confirm that the sets of estimated coefficients for NOW accounts are statistically different between California and non-California banks. We find weaker evidence of differential responses for MMDAs.

If California banks respond differently to interest rate determinants than banks elsewhere, as the above tests suggest, then we wish to find how much of the observed discrepancies can be attributed to these different responses. To accomplish this, we re-estimate the regressions in Table 2, including dummy variables for California banks interacted with the other explanatory variables. The estimated coefficients on these interacted variables represent the marginal effects of the explanatory variables for California banks, over and above their effects for the sample as a whole. The results from these estimates are presented in Table 3.

Looking first at the results from the NOW account regression, we find estimated coefficients for the non-interacted variables that are extremely close to the estimates in Table 2, with the exception of the coefficient on overhead expenses. Among the interacted variables, we observe a large negative intercept term and a large positive coefficient on concentration, both of which are statistically significant. Among the remaining interacted variables, the two cost measures are both statistically significant (with opposite signs), and we observe a large positive coefficient on market deposit growth.

Using this new set of estimated coefficients, we can calculate the implied deposit interest rates paid by a bank with average sample characteristics for a non-California bank, operating in an average sample, non-California market. For purposes of this exercise, we exclude the effects of unit banking and limited branching restrictions. With these same non-California average sample values, we can then determine the interest rate this bank would charge if it were to respond to the explanatory variables as the California banks do. The difference between these two estimates provides an indication of the extent to which California banks respond differently to rate determinants. This difference is then compared to the observed differentials.[21]

Using this approach to generate the NOW account deposit interest rate implied by the average non-California sample values of the explanatory variables, we obtain a rate of 5.21 percent. By inducing this bank to act like its California counterpart, we get an interest rate of 5.31 percent *using the same average sample values*. In effect, the marginal influence of the different response of California banks is to raise the NOW rate *above* that for the rest of the nation. Allowing for a different response of California banks to the determinants of deposit interest rates suggests that California banks ought to pay *higher* deposit interest rates on NOWs, not lower ones. These differential responses thus provide no explanation for the interest rate disparity we observe on NOW accounts.

Pursuing this same exercise for MMDA deposit rates, we find fewer significant interacted explanatory variables. Only two of these variables, a negative intercept and a positive coefficient on overhead expenses, are significant at the one percent level. A positive coefficient on concentration is also significant at the five percent level. The marginal effects of the different responses of California banks to the model's explanatory variables are thus smaller for MMDAs than for NOWs. Calculating the interest rates implied by these estimated coefficients, we obtain 6.63 percent for the average non-California bank, and 6.44 percent for an average bank that acts like a California bank. This differential of 19 basis points suggests that differences in the behavioral response of California banks to the determinants of deposit interest rates explain approximately two-thirds of the observed interest rate discrepancy in MMDA rates of 28 basis points from 1984-87. The remaining discrepancy is due either to the unique charac-

Table 3

Deposit Rate Regressions, 1984–87: Variables Interacted with CA Dummy

	Dependent Variable (rate in basis points)	
Independent Variable	NOW (1986–87)	MMDA
Constant	393.79**	102.69**
	(44.43)	(16.43)
3-Firm Concentration Ratio	−17.19**	−13.93**
	(−4.58)	(−3.59)
Market Deposit Growth Rate	19.71**	16.65**
	(3.98)	(3.28)
Per Capita Bank Offices in State	0.43	8.26**
	(0.39)	(6.47)
Bank Assets	0.72**	0.71**
	(4.68)	(4.42)
Number of Branches	−0.11**	−0.05**
	(−7.40)	(−3.31)
Retail Time as % of Total Deposits	−0.07	−0.45**
	(−1.49)	(−9.18)
Overhead Expenses per $ Assets	−2.46**	−1.88**
	(−3.66)	(−2.61)
Average Salary	−0.59**	−1.73**
	(−5.22)	(−14.04)
Limited Branching Dummy	−7.60**	−3.57*
	(−5.14)	(2.30)
Unit Banking Dummy	3.70	20.12**
	(1.57)	(8.41)
Money Market Fund Rate	0.26**	0.83**
	(22.37)	(190.05)
CA*Constant	−138.75**	−97.85**
	(−3.71)	(−3.51)
CA*3-Firm Concentration Ratio	158.39**	72.80*
	(4.88)	(2.00)
CA*Market Deposit Growth Rate	461.47**	45.69
	(8.14)	(0.99)
CA*Bank Assets	2.39*	0.14
	(1.96)	(0.13)
CA*Number of Branches	−0.11	−0.02
	(−1.42)	(−0.31)
CA*Retail Time as % of Total Deposits	−0.07	0.14
	(−0.36)	(0.64)
CA*Overhead Expenses per $ Assets	13.87**	5.75**
	(7.75)	(2.84)
CA*Average Salary	−2.48**	−0.53
	(−6.89)	(−1.34)
CA*Money Market Fund Rate	0.02	0.02
	(0.34)	(1.29)
R-Bar Squared	0.269	0.866
No. of Observations	3415	6573

Notes: *(**) indicates coefficient significantly different from zero at the 5 (1) percent level; t-statistics in parentheses.

teristics of California banks and the state's bank markets, or to a misspecified deposit interest rate model.

The results of these tests indicate that relaxing the constraint that all banks in the sample act the same "explains" a considerable proportion of the rate mystery for MMDAs. Allowing for differences in bank behavior, however, explains virtually none of the interest rate discrepancies for NOWs. Of course, finding evidence that banks in California are different from those elsewhere begs the more fundamental question why this should be so.

It is also difficult to attribute portions of the differentials to the explanatory variables. The Table 3 regression for NOWs, for example, shows a large negative interacted constant, suggesting a shift in the level of rates by California banks. This level shift is offset by a large positive coefficient on interacted market concentration, a result that is contrary to the theoretical predictions of the structure-performance hypothesis and with the empirical results for the rest of the sample. While the positive coefficient on interacted concentration is consistent with the efficient structure hypothesis discussed in Section II above, the magnitude of the implied price effect makes it seem unlikely that California banks are that much more efficient than those elsewhere. We therefore put little credence in this interpretation of the results. These findings are thus difficult to explain and contribute little to identifying the sources of the NOW rate mystery.

An alternative avenue of research is to investigate other ways in which market power may manifest itself. There is reason to believe that local market concentration ratios may not be adequate measures of market power in California banking. Banks in the state have large, statewide branching networks and appear to price their deposits on a statewide basis. Market power in California, therefore, may be exercised by banks in a way that is not well captured by this traditional measure of local market concentration. One suggestion by Neumark and Sharpe (1989) is that market power may manifest itself in the rate at which deposit rates adjust to changes in market interest rates. Specifically, banks that exercise market power may adjust deposit rates more slowly in an upward direction than in a downward direction. If this is true, then in markets where banks have market power, we would observe deposit rates lagging market interest rates when rates are rising, but declining in concert with market rates when rates are falling.

In an attempt to address this issue, we estimated different regressions for periods when rates were rising and falling, and found some evidence that the California dummy variable was larger in periods of rising rates than in periods of falling rates for both transaction accounts. While this finding is consistent with California banks

exercising market power in adjusting their deposit interest rates, an extensive analysis of this dynamic adjustment model is beyond the scope of this paper. It does suggest, however, that additional research in this area may prove fruitful.

V. Summary and Conclusion

In this paper, we explore the so-called California deposit rate mystery. We confirm that California banks paid lower deposit rates on two kinds of retail transactions accounts than non-California banks during the 1984-1987 sample period. For two maturities of time certificates of deposit, the estimated interest rate differentials are smaller and less distinctive. There is less evidence, therefore, that the deposit rate mystery extends to time CDs. Our results suggest that the discrepancies are primarily a phenomenon associated with transaction-based accounts. We also find that the unique characteristics of banking markets in California account for approximately one-third of the observed differentials.

We then estimate regression equations for these transaction-based accounts that permit the behavior of California and non-California banks to vary and find significant differences in the responses of the two samples of banks to the model's explanatory variables. Allowing for these different responses is sufficient to eliminate two-thirds of the predicted interest rate discrepancies for MMDAs, but "explains" very little of the differential for NOWs.

Despite these positive findings, the California deposit rate mystery remains an interesting puzzle. For example, we cannot explain why California banks act differently from banks elsewhere. It appears that state borders have shielded banks in California from the influences affecting banks in other states. The importance of these borders will decline in 1991 when California allows full interstate banking. Will the different pricing behavior of California banks continue after 1991, or will banks in the state come to resemble those elsewhere? Perhaps even more interesting, will non-California bank holding companies acquiring banks in California continue to behave as they previously did outside the state or will they act like their California counterparts in setting deposit interest rates? The answers to these questions, and the final resolution to the rate mystery itself, likely will have to wait until after 1991.

NOTES

1. Data are from the Monthly Survey of Select Deposits (FR 2042 Report). The most common interest rates paid on several retail deposit accounts are collected as of the close of business on the last Wednesday of the month from a sample of approximately 435 banks nationwide. The sample includes institutions of all size categories. We use the observation for the last month in the quarter to obtain a quarterly time series on deposit rates.

2. To determine the statistical significance of these differentials, we regressed the average rate paid by California banks in the sample against a constant term and the average rate paid by all banks in the sample. A significant estimated constant term indicates that the differences in the interest rates are statistically significant.

3. See Neuberger and Zimmerman (1989) for additional discussion.

4. See the extensive surveys by Gilbert (1984) and Rhoades (1977,1982) for discussion and analysis of these studies.

5. Smirlock (1985) tests this hypothesis on a sample of unit banks during the 1970s. His analysis shows that once market share is accounted for, concentration has no explanatory power for bank profitability. In contrast, market share is positively and significantly related to bank profitability even after controlling for concentration. Smirlock interprets these results as contrary to the structure-performance hypothesis and supportive of the efficient structure hypothesis. He argues that market concentration is indicative not of collusive market power but of the superior efficiency of leading firms.

6. Although limited transaction MMDA deposits generally are drawn from a bank's local market area, Keeley and Zimmerman (1985) found no evidence to support the hypothesis that MMDA markets in California were local. However, their analysis did find evidence of local markets for the Super NOW account, which pays market rates and provides full transaction services, and is similar to the NOW accounts studied here.

7. An alternative specification of the model, using quarterly time dummies in place of the money market mutual fund interest rate produced similar regression results. The interest rate on money market funds moves closely with open market interest rates. In addition, money market funds compete directly with retail deposit products offered by banking institutions.

8. In our empirical estimates, we use the number of branches owned and operated by each bank. A reasonable case can be made that this number should be normalized, for example, by dividing by market population or market size. However, it is not clear which is the appropriate standard for the normalization. We tried several normalization techniques and obtained similar results to the estimates using only the number of branches. We thus chose to use the number of branches.

9. The most common interest rates paid during the month for each deposit category are reported for each bank in the survey. We define the bank's local market as the MSA or non-MSA county in which the home office is located. In this way, we apply the most common interest rate to a local market. This means we have one observation per time period for each bank. Bank characteristic data were obtained from call reports, which are available on a quarterly basis. The interest rate data are monthly time series. We used the last monthly observation in each quarter. Note that data for NOW accounts are available starting in 1986. The NOW regressions were thus estimated on approximately 3500 observations from 1986 to 1987.

10. This was also a period when California banks lost a significant share of the deposit market to thrifts. Thrift institutions in the state accounted for more than half of total domestic deposits by the end of the period, far higher than the national average.

11. In 1987, the 3-firm concentration ratio of 55.0 for the entire state (including all banks and all markets) ranked 15th out of the 50 states, although California was not statistically significantly different from the mean across all states of 46.6 percent.

12. These estimates are analogous to those reported in Berger and Hannan (1989), with the sample updated to include quarterly data for 1986 and 1987.

13. These results are consistent with the findings of Berger and Hannan (1989), although our estimated coefficients are considerably smaller than theirs. There are a number of potential reasons for the different estimated coefficient on the concentration ratio between our study and that of Berger and Hannan. First, our specification contains several variables that they do not include in their estimated equations. The results of the two studies, therefore, are not perfectly comparable. More importantly, there is evidence that the relationship between market concentration and bank deposit pricing decisions is changing over time. To test this hypothesis, we split the sample in half and ran the same regressions over the two intervals. In the MMDA regressions, the coefficient on concentration was twice as large in the 1984-85 regression as it was in the 1986-87 estimates. These estimated coefficients were significantly different from one another at the 5 percent level. While the 1984-85 results are closer to the findings of Berger and Hannan than the whole-sample regressions, we still estimate significantly smaller concentration coefficients than they do.

14. This result conflicts somewhat with the results reported by Keeley and Zimmerman (1985). Using a limited sample of nine western states that allowed statewide branching, those authors found a significant, negative relationship between interest rates on MMDAs and a state-level market concentration measure, but no significant relationship between MMDA rates and local market concentration.

15. We examined other maturities of retail CDs and generally found similar results. The estimates for the various CDs were generally quite consistent and significantly different from the transactions accounts.

16. It is plausible that banks may allocate some overhead costs to these savings instruments. However, most banks generate little fee income from these accounts to offset this overhead. In contrast, banks charge for many services associated with transaction accounts, i.e., monthly charges and per item fees to name a few, and this fee income may reduce the strength of any relationship between gross overhead costs and interest rates on these accounts.

17. The estimated coefficient on the California dummy variable for the three- to six-month CD may give some indication of the costs associated with switching bank accounts. Flannery (1982) has suggested that bank accounts involve quasi-fixed costs that prevent a complete adjustment of deposit interest rates to closely competitive instruments, such as other market rates or rates at competing depository institutions. Over a year, an eight basis point difference in deposit rates translates to a loss of only eight dollars on a $10,000 account. This may be too little to induce many CD holders to find alternative investments.

18. The results presented in Table 2 are consistent with those reported in Berger and Hannan's paper: market concentration is associated with lower deposit interest rates for MMDAs but not with lower longer-term CD rates. The addition of two years of data to the sample has not altered the basic findings of their study. Moreover, the additional period allows us to include NOW accounts in our analysis, confirming the results for transaction-oriented accounts.

19. The rate mystery may also extend to other major states. One version of the model included dummy variables for several major banking markets, including New York, Illinois, Pennsylvania, Michigan, Texas, and California. The results indicate that rates in a number of these states also differed from the sample average by statistically significant amounts.

20. We know from observing the pricing behavior of California banks that many of these institutions employ a statewide policy of setting deposit interest rates. That is, an account at a major California bank receives the same interest rate whether it is at a branch in a remote rural area of the state or in a densely populated urban center. California banks have thus chosen to ignore to some degree local market conditions in setting interest rates on their deposit accounts, a decision which may not apply to other markets.

21. In order to generate the "average sample" interest rates presented below, we use average sample values of the explanatory variables for the non-California sample of banks, and multiply them by the estimated coefficients (excluding the interacted variables) in Table 3. Sample periods are 1986-87 for NOWs and 1984-87 for MMDAs. We then add to these estimates the same non-California average sample values multiplied by the corresponding interacted coefficients, including the interacted constant term. The result is the interest rate the average non-California bank would pay if it were to act like the California banks in our sample.

REFERENCES

Berger, Allen and Timothy Hannan. "The Price-Concentration Relationship in Banking," *Review of Economics and Statistics,* 71, 1989. pp. 291-99.

Demsetz, Harold. "Industry Structure, Market Rivalry, and Public Policy," *Journal of Law and Economics,* 16, 1973. pp. 1-9.

Flannery, Mark. "Retail Bank Deposits as Quasi-Fixed Factors of Production," *American Economic Review,* 72, 1982. pp. 527-36.

Gilbert, Alton. "Studies of Bank Market Structure and Competition: A Review and Evaluation," *Journal of Money, Credit, and Banking,* 16, 1984. pp. 617-44.

Hannan, Timothy. "Foundations of the Structure-Conduct-Performance Paradigm," *Finance and Economics Discussion Series,* No. 83, Board of Governors of the Federal Reserve System, 1989.

Keeley, Michael and Gary Zimmerman. "Determining Geographic Markets for Deposit Competition in Banking," *Economic Review,* Federal Reserve Bank of San Francisco, 1985. pp. 25-45.

Neuberger, Jonathan and Gary Zimmerman. "The California Deposit Rate Mystery," *Weekly Letter,* Federal Reserve Bank of San Francisco, Jan. 27, 1989.

Neumark, David and Steven Sharpe. "Market Structure and the Nature of Price Rigidity: Evidence from the Market for Consumer Deposits," unpublished manuscript, Board of Governors of the Federal Reserve System, 1989.

Peltzman, Samuel. "The Gains and Losses from Industrial Concentration," *Journal of Law and Economics,* 20, 1977. pp. 229.63.

Rhoades, Stephen. "Structure-Performance Studies in Banking: A Summary and Evaluation," *Staff Economic Studies,* No. 92, Board of Governors of the Federal Reserve System, 1977.

_____. "Structure-Performance Studies in Banking: An Updated Summary and Evaluation," *Staff Economic Studies,* No. 119, Board of Governors of the Federal Reserve System, 1982.

Smirlock, Michael. "Evidence on the (Non) Relationship Between Concentration and Profitability in Banking," *Journal of Money, Credit, and Banking,* 17, 1985. pp. 69-83.