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Chapter Author(s): Sherman J. Maisel, Robert Jacobson

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Interest Rate Changes and Commercial Bank Revenues and Costs

Sherman J. Maisel and
Robert Jacobson

9.1 Introduction

In this chapter we statistically examine several issues. These are concerned with the degree to which banks react to changes in their rates of return from different activities. How closely and over what time periods do banks adjust their assets and liabilities to equalize expected risk-corrected marginal rates of return? A major related question is the degree to which interest rate ceilings influence bank returns. Given regulation Q, do banks gain or lose as interest rates shift? In seeking answers, it is useful to differentiate between wealth effects and income effects. Thus, with rising rates a bank might gain from ceilings if fixed cost deposits funded higher yielding assets (a wealth effect), but the bank might lose as much or more if the shift in rates caused most of its deposits to leave (an income effect).

The degree and rapidity with which financial institutions react to new information and shift funds among asset and liability classes so as to equalize marginal costs and returns is critical in the study of financial markets. Many analysts assume that markets are efficient, that transaction and information costs are negligible or unimportant, and that borrowing and lending, hedging and arbitrage are simple and are available at or at close to risk-free rates. As a result, they believe that they can successfully predict the results of all types of market actions and reactions without concern for institutional forces.

On the other hand, large numbers of observers believe that the markets within which financial institutions operate are so far removed from these assumptions that different theories and analyses must be applied. This is particularly true with respect to competition, legal and institutional restrictions, and information and transaction costs.

Our results fall between the extreme views. Rates of returns and costs adjust toward each other, as they should in a competitive market. On the other hand, the rates of adjustment are slow, particularly if we estimate total (in contrast to book) returns. Average book returns for classes of assets over the past sixteen years are not too far apart, but this is not true for total returns. Furthermore, no indication exists that over this period the net returns of classes of assets were related to their risk (their variance of returns).

Since the data include corrections for operating costs as well as for defaults and losses, it does appear that institutions adjust rather readily to costs they record on their books. A few major exceptions to such adjustment exist, as, for example, the low indicated return on nonhome mortgages in years such as 1973 to 1975. This seems to be an obvious result of the general euphoria and speculation that characterized this sphere in the early 1970s. The net return on consumer loans also does not respond rapidly to sharp movements in costs.

While major problems arise in measuring year-to-year fluctuations in actual returns caused by shifting interest rates, such movements have been significant. In critical years such as 1969, 1973, 1974, and 1977, for example, the rate of return on earning assets for an average bank fell 100 to 500 basis points below that reported based on book values. Since net book returns (before taxes) as a percentage of loans and investments for an average bank were about 1.20 percent of assets in this period, in these years the typical bank probably ran a true deficit that ranged up to 3.0 percent of assets. Such losses must be evaluated in light of a capital asset ratio of 9 percent, which the average bank held during this period.

Since such losses tended to decrease or even reverse in the next year for a typical bank, they were not too critical. However, the same is not true for banks that varied far from the average either in their portfolio or in capital. The variation in net returns or losses among classes of assets in a year can be large. In the past, many institutions were in jeopardy from interest rate movements. In the future, for those with unbalanced portfolios or low capital, potential dangers appear to be sizable.

9.2 The Basis of the Estimates

Our study is based upon estimated statistical cost and revenue curves for a cross section of banks in the years 1962–77 (with the exception of 1969). These estimates are of net rates of income and costs based upon book values of assets. The rates are net of servicing, processing, overhead costs, and so forth. The rates are estimated in each year from the fact that each individual bank holds a somewhat different mix of assets and liabilities. When the actual costs and revenues are regressed on the differing assets and liabilities, the regression coefficients estimate the effect on

rates of return of placing a dollar in a particular class of assets or liabilities under the economic conditions of the given year. Net rates are obtained by subtracting the costs for an asset from its estimated gross revenues. The estimated cost and revenue curves are shown in table 9.1.

These statistical cost and revenue curves for a cross section of banks follow a technique used and explained in detail in studies by Hester and Zoellner (1966) and Hester and Pierce (1975). This study differs from theirs by using a national sample over a large number of years and in the methods of estimation.

The basic model used in estimation consists of two equations:

$$(1) \quad \frac{R_i}{A_i} = \frac{b_0}{A_i} + b_1 \frac{A_{li}}{A_i} + \dots + b_k \frac{A_{ki}}{A_i} + \frac{e_i}{A_i}.$$

$$(2) \quad \frac{C_i}{A_i} = \frac{c_0}{A_i} + c_1 \frac{A_{li}}{A_i} + \dots + c_k \frac{A_{ki}}{A_i} + c_{k+1} \frac{L_1}{A_i} \\ + \dots + c_{k+j} \frac{L_{ji}}{A_i} + \frac{u_i}{A_i}.$$

The first equation shows the gross revenues (R_i) from earning assets in a given year from a particular bank (i) related to the book value for each class (k) of assets (A_{ki}) for that bank in that year. The second equation relates the operating expenses (C_i), including actual net loan losses less income from deposit service charges, to the book value for categories of assets (A_{ki}) and liabilities (L_{ji}). The coefficients of the equations are estimates of the gross revenues and costs for each type of asset and liability. The difference between costs and revenues for an asset is its net return.

In each case the variables on both sides have been divided through by the level of assets in the year to correct for the heteroskedastic nature of banks with their widely varying sizes. This correction means that, with the exception of the first right-hand variable, which is $1/A_i$, all other variables are expressed as a percentage of total assets. A Goldfeldt-Quandt test (1965) for heteroskedasticity was employed, and the assumption of homoskedasticity could not be rejected.

While Ordinary Least Squares (OLSQ) run separately on equations (1) and (2) would give unbiased estimates of the coefficients and standard errors, they would not be efficient. It is known that the error terms across equations for corresponding observations are likely to be correlated. Variables that influence bank behavior but that are not included as independent variables and so show up in the error terms are likely to be partly the same for both equations. This knowledge can be used and efficiency increased by taking account of the correlation across equations. This has been done by using Zellner's seemingly unrelated equation

Table 9.1 Rates of Book Returns and Costs of Classes of Assets and Liabilities for a Sample of Commercial Banks (in Percent per Year)

| Class of Asset or Liability | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 ^a | 1977 ^a |
|---|-------|-------|-------|-------|------|------|------|------|------|-------|-------|-------|-------|-------|-------------------|-------------------|
| <i>Securities</i> | | | | | | | | | | | | | | | | |
| U.S. Treasuries and agencies | 3.43 | 3.50 | 3.77 | 3.86 | 4.30 | 4.54 | 4.57 | | 5.62 | 5.60 | 5.43 | 5.42 | 5.91 | 6.00 | 6.31 | 6.23 |
| Federal funds and other securities | 2.34* | 3.35* | 2.17* | 2.36* | 3.50 | 4.70 | 3.50 | | 5.04 | 4.19 | 4.83 | 7.46 | 9.14 | 6.10 | 5.24 | 4.87 |
| State and local securities | 3.38 | 3.13 | 3.29 | 3.36 | 3.27 | 3.69 | 4.16 | | 5.02 | 4.55 | 4.74 | 4.79 | 5.35 | 6.13 | 5.72 | 5.71 |
| <i>Loans, net</i> | | | | | | | | | | | | | | | | |
| 1-4 family mortgages | 3.89 | 4.00 | 3.98 | 4.08 | 4.55 | 4.61 | 4.77 | | 5.43 | 5.70 | 5.49 | 5.20 | 5.66 | 5.57 | 6.38 | 6.22 |
| Other mortgages | 3.79 | 3.43 | 4.01 | 3.72 | 4.15 | 4.34 | 4.56 | | 5.03 | 5.61 | 5.26 | 5.54 | 4.45 | 4.19 | 6.13 | 6.57 |
| Commercial, industrial, financial, farm, other loans | 3.85 | 4.00 | 3.87 | 3.79 | 4.13 | 4.58 | 4.92 | | 5.28 | 5.22 | 5.17 | 5.62 | 6.57 | 6.17 | 6.10 | 6.47 |
| Consumer loans | 3.23 | 3.76 | 4.09 | 4.06 | 4.56 | 4.85 | 5.44 | | 4.66 | 5.30 | 5.42 | 5.84 | 6.00 | 5.73 | 4.40 | 4.88 |
| Interest-bearing balances with banks | | | | | | | | | | | | | | | 5.43 | 4.21 |
| <i>Liabilities</i> | | | | | | | | | | | | | | | | |
| Demand deposits | 1.45 | 1.53 | 1.61 | 1.52 | 1.73 | 2.01 | 2.21 | | 2.37 | 2.72 | 2.73 | 2.84 | 3.24 | 3.93 | 2.96 | 2.97 |
| Time and savings deposits | 3.18 | 3.43 | 3.44 | 3.47 | 3.85 | 4.11 | 4.31 | | 4.66 | 4.84 | 4.77 | 4.79 | 5.23 | 5.16 | 5.38 | 5.26 |
| Purchased money, including federal funds | | | | | | | | | 4.22 | 3.52 | 3.49 | 6.25 | 8.48 | 4.75 | 7.05 | 7.20 |
| <i>Loans, gross</i> | | | | | | | | | | | | | | | | |
| 1-4 family mortgages | 5.03 | 5.12 | 5.28 | 5.43 | 5.61 | 5.41 | 5.53 | | 6.03 | 6.21 | 6.64 | 6.82 | 6.86 | 6.89 | 7.87 | 8.14 |
| Other mortgages | 6.94 | 6.24 | 6.56 | 6.50 | 6.41 | 6.85 | 6.88 | | 7.29 | 8.32 | 8.04 | 8.83 | 9.46 | 9.21 | 8.89 | 9.35 |
| Commercial, industrial, financial, farm, other loans | 5.63 | 5.86 | 6.02 | 6.01 | 6.29 | 6.52 | 6.98 | | 8.44 | 7.57 | 7.15 | 8.56 | 10.60 | 8.90 | 8.91 | 8.94 |
| Consumer loans | 8.18 | 8.21 | 7.83 | 7.86 | 8.13 | 8.23 | 8.92 | | 9.87 | 10.41 | 10.10 | 10.46 | 10.78 | 11.57 | 11.36 | 11.22 |
| Interest-bearing balances with banks | | | | | | | | | | | | | | | 9.10 | 6.40 |
| Rate on three-month Treasury bills | 2.77 | 3.16 | 3.54 | 3.95 | 4.86 | 4.29 | 5.34 | 6.68 | 6.39 | 4.33 | 4.07 | 7.03 | 7.84 | 5.80 | 4.98 | 5.27 |

Note: 1962-75 based on data from an FDIC 980-bank sample. Rates are the coefficients from a regression of revenues on loans and investments and costs on liabilities. All coefficients are significant at the 0.99 level, with the exception of those marked with an asterisk.

*Not significant at the 0.99 level.

^aData are from consolidated statements (cf. text and p. 446, *Federal Reserve Bulletin*, June 1978).

estimation (1962). The differences from OLSQ are rarely large, but they are significant.

9.3 The Data

The data used in this study for the years 1962–75 come from the Federal Deposit Insurance Corporation's stratified sample of Reports of Condition and Income. This sample covers 978 identical banks for the period 1961–68 and a somewhat different group of 980 banks for 1969–75. It includes the end-of-year and midyear call reports. There was a change in reporting between the 1968 and 1969 reports that has some influence on the choice of variables and causes the omission of much data for 1969 from the analysis. An additional change occurred for the years 1976–77. Data are from a 20 percent sample of all banks. Data are from consolidated balance sheets and income statements. Interest from balances with other banks is shown separately, and over \$100,000 certificates of deposit are included in purchased money rather than in time and savings deposits. These changes for 1976 and 1977 affect the comparability of the costs for all liabilities.

In 1975 the sample contains 186 banks with over \$500,000,000 in assets; 195 banks between \$200,000,000 and \$500,000,000; 196 between \$50,000,000 and \$200,000,000; 252 between \$10,000,000 and \$50,000,000; and 151 banks under \$10,000,000 in assets. The sample is approximating random within categories with some adjustments to ensure continuity. Such a sample, it is well known, gives unbiased estimates.

The income data cover the entire year as reported in the annual Reports of Condition (calls), the asset data are weighted averages of the final and midyear reports for the designated year and the final report for the previous year, with weights of $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{1}{4}$, respectively. Cash, bank balances, and items in process have been subtracted from reported demand deposits as an estimate of net demand deposits.

The data were run for the entire sample and for five subclasses by size. Chow tests indicated that one could not reject the hypothesis that there were no significant differences in net revenues and costs among the different size groups. The results for the smallest size group are more erratic than the results for the others and also on the whole show higher revenues and costs, but they still fall within the normal distribution for the entire sample.

Various problems are known to exist with the data that cause less than ideal results. Most important is the fact that the data report book income, costs, and asset values. These differ from economic variables because rates of return and the amount of assets are not corrected for changes in market values. Furthermore, economic periods of adjustment are unlikely to equal a year. Table 9.5 and the discussion of it show how rough

corrections can be made to get actual economic returns and the considerable difference in analysis that result.

Because of window dressing, reported assets on call dates are known to be biased estimates of daily averages. The biases are small for most assets and liabilities, but they are significant for items such as federal funds. Miscellaneous assets or liabilities have been grouped together to decrease this problem, but biases almost certainly remain for these items. Total estimated rates of return and costs are perhaps 2 percent (about 5 to 10 basis points) less as a result of this problem.

Some sources of income and expense cannot be directly related to items on the balance sheet. This is true, for example, of income from fiduciary activities. To correct partially for such income and related costs, we have used as gross revenue the sum of all income reported for each type of earning asset. We have subtracted this amount from reported income to estimate that from other sources and have then subtracted this sum from both revenues and expenses. In effect, this assumes that banks break even on their miscellaneous activities and that costs and revenues for their loan and investment activities can be estimated with only minor biases from this correction. Since this gross correction is less than 7 percent of the total, any bias arising from a net difference between costs and revenues for these miscellaneous items is likely to be small.

A related problem arises in attempting to allocate investment expenses among classes of securities. From Federal Reserve *Functional Cost Analysis* we find that expenses for portfolio investments are less than 0.01 percent of the total. The difficulties of estimating the distribution of this small sum are great enough so that we exclude the costs of managing the securities' portfolio from our estimations, even though this means that net revenues from securities are overestimated by 3 to 10 basis points. This may approximately offset the opposite bias from use of call dates, but there will be small variations from year to year.

The most important difference between the data for 1962–68 and those for 1970–75 is in the treatment of sales and purchases of federal funds. In the earlier period, such sales are included in commercial and other loans, while in the later period they are included in federal funds and other securities owned. This is done to follow bank reporting that included sales of federal funds as part of loans to financial institutions in the earlier period but reported them separately in the later period. Purchases of federal funds in the earlier period were included in other liabilities. This causes a major difference in estimates of purchased money for the earlier period, and for this reason the results are not shown. Other minor definitional changes also occurred in 1969, but their effect is believed to be slight. The 1976 changes primarily affect the 145 large banks with foreign deposits as well as the definition of time and savings deposits and purchased money.

9.4 Results

Tables 9.1, 9.2, and 9.3 report the results of the statistical analysis of book returns. Table 9.1 shows the net and gross revenues for seven classes of assets (eight in 1976–77), three classes of liabilities, and the market rates on three-month Treasury bills, by year. Table 9.2 shows the means and standard deviations for each asset, both for the entire period and for the two subperiods. There was a major shift in the level of rates between the two periods. Thus, even though they cover a shorter period, the data for 1970–77 appear of greater interest and more relevant at present.

Table 9.3 shows the correlations between the returns on United States securities and the various other rates both for the entire period and for the two subperiods.

Table 9.2 Average Rates of Book Returns and Costs for Classes of Assets and Liabilities

| Class of Asset or Liability | 1962–68 | | 1970–77 | | 1962–77 ^b | |
|---|---------|-------------------|---------|-------|----------------------|-------|
| | Mean | S.D. ^a | Mean | S.D. | Mean | S.D. |
| <i>Securities</i> | | | | | | |
| U.S. Treasuries and agencies | 4.00 | .475 | 5.81 | .348 | 4.97 | .985 |
| Federal funds and other securities | 3.13 | .906 | 5.85 | 1.659 | 4.59 | 1.861 |
| State and local securities | 3.47 | .349 | 5.25 | .565 | 4.42 | .994 |
| <i>Loans, net</i> | | | | | | |
| 1–4 family mortgages | 4.28 | .350 | 5.71 | .400 | 5.04 | .801 |
| Other mortgages | 4.00 | .390 | 5.35 | .799 | 4.72 | .900 |
| Commercial, industrial, financial, farm, other loans | 4.16 | .428 | 5.83 | .573 | 5.05 | .956 |
| Consumer loans | 4.29 | .731 | 5.29 | .582 | 4.81 | .786 |
| <i>Liabilities</i> | | | | | | |
| Demand deposits | -1.72 | .284 | -2.97 | .461 | -2.39 | .720 |
| Time and savings deposits | -3.68 | .414 | -5.01 | .275 | -4.39 | .736 |
| Purchased money, including federal funds | | | -5.62 | 1.881 | | |
| <i>Loans, gross</i> | | | | | | |
| 1–4 family mortgages | 5.34 | .212 | 6.93 | .735 | 6.19 | .947 |
| Other mortgages | 6.62 | .267 | 8.67 | .744 | 7.72 | 1.154 |
| Commercial, industrial, financial, farm, other loans | 6.18 | .452 | 8.63 | 1.034 | 7.49 | 1.439 |
| Consumer loans | 8.19 | .360 | 10.72 | .616 | 9.54 | 1.348 |
| Rate on three-month Treasury bills | 3.99 | .917 | 5.71 | 1.310 | 4.91 | 1.372 |

^aStandard deviation.

^b1969 was not included in the calculations.

Table 9.3 Correlations between Book Rates of Returns on United States Securities (Governments and Agencies) and Other Assets and Liabilities

| Class of Asset or Liability | Actual | | | First Differences | |
|---|---------|---------|----------------------|-------------------|---------|
| | 1962-68 | 1970-77 | 1962-77 ^a | 1963-68 | 1971-77 |
| <i>Securities</i> | | | | | |
| U.S. Treasuries and agencies | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Federal funds and other securities | .71 | -.02 | .74 | .34 | .08 |
| State and local securities | .73 | .85 | .95 | -.19 | .21 |
| <i>Loans, net</i> | | | | | |
| 1-4 family mortgages | .97 | .88 | .98 | .53 | .77 |
| Other mortgages | .90 | .29 | .80 | .67 | -.06 |
| Commercial, industrial, financial, farm, other loans | .84 | .79 | .95 | .18 | .44 |
| Consumer loans | .95 | -.43 | .70 | .07 | -.48 |
| <i>Liabilities</i> | | | | | |
| Demand deposits | -.91 | -.46 | -.91 | -.39 | .14 |
| Time and savings deposits | -.97 | -.93 | -.99 | -.41 | -.85 |
| Purchased money, including federal funds | | -.60 | | | -.37 |
| <i>Loans, gross</i> | | | | | |
| 1-4 family mortgages | .85 | .80 | .91 | -.03 | .09 |
| Other mortgages | .33 | .60 | .90 | .35 | -.01 |
| Commercial, industrial, financial, farm, other loans | .93 | .54 | .90 | -.05 | .49 |
| Consumer loans | .53 | .84 | .95 | .27 | .16 |
| <i>Rate on three-month Treasury bills</i> | .92 | -.02 | .69 | -.06 | .04 |

^a1969 was not included in the calculations.

Several facts stand out from the tables. (It should be recalled that all results in these tables are for book income.)

1. While net returns to a class of assets differ considerably from year to year, they are fairly close when a number of years are averaged together. In fact, one cannot reject the hypothesis that on average their rates are the same.

2. These convergences in net returns occur despite wide divergences in gross returns. The higher gross payments reflect higher costs. This is particularly true for consumer loans and nonhome mortgages.

3. Some classes of assets with high risks (for example, nonhome mortgages) have among the lowest returns. Decisions are based on expectations that can turn out to be very wrong.

4. Except for federal funds and other securities, any relationship between book rates of return and the standard deviation or variance of these returns is weak or nonexistent.

5. The correlation among the assets and liabilities and even their year-to-year changes tends to be high. There are two major exceptions. In the period 1970–77, returns on consumer loans and on federal funds had inverse correlations.

6. In the recent period also, the year-to-year movements of rates on three-month Treasury bills have been far more volatile and have not been well correlated with movements of other rates. Part of this difference occurs because the other returns are reported on a book basis rather than on a market basis. These book data tend to even out some of the year-to-year fluctuations in actual returns. This averaging process does not affect the return on the short-term Treasury bills.

7. While movements in the costs of demand and time deposits correlate well with changes in market rates, the effect of regulation Q in holding these costs down is evident. Some, but far from all, of the advantages of regulation Q to banks are given up to depositors or borrowers.

The average rate of return for the entire period for holdings of United States government securities, for most loans, and for Treasury bills are close. While significant differences occur on a year-to-year basis, they average out.

The sharpest year-to-year movements occur in the cost and revenues for federal funds and other securities and in the cost of borrowed money, which in the later period is dominated by purchases of federal funds. These returns move with changes in short-term Treasury bills. Superficially it appears that in recent years lending federal funds is the most profitable activity for a bank. This may well be true, but unfortunately these numbers have considerable bias, since the asset numbers are heavily influenced by window dressing on call dates.

Among the other assets, major divergences exist for the returns on nonresidential mortgages and consumer loans. Nonresidential mortgage loans show low returns, particularly in the years 1974–75. As noted, this reflects the fact that investment decisions are based on expectations that can be heavily influenced by market sentiments and that can turn out to be very wrong. Banks as a group were carried away by the real estate investment boom. Such errors with a lag led to the low returns of 1974–75 as losses, caused by the prior overenthusiastic lending, had to be charged off.

The lower reported return for state and local securities is expected, the only unusual feature being the high returns for the years 1975–77. Such very high returns are shown in the reports of individual banks.

Costs of money move with interest rates. This is particularly true for purchased money, but market rates also influence the costs of time and savings deposits. Regulation Q was completely removed for large certificates of deposit in 1973 and did not apply to most large certificates after mid-1970. Of course, during the earlier period, the ceilings were at times above market rates.

9.4.1 Deposit Rates

On the other hand, regulation Q apparently does hold the costs for demand deposits through services granted well below amounts paid for other funds. It is not true that costs adjust so that demand deposits have the same marginal costs as other funds. Whether because the ceiling acts as a form of price leadership or because of other oligopolistic features, banks do not completely compete away the advantages they gain from interest rate ceilings.

An examination of asset returns also makes it appear that the advantages gained through regulation Q are not given up in the form of lower returns on loans to particular classes of borrowers. There is no evident difference between the net rates earned on separate classes of loans. Net income earned from customers who would be expected to hold large balances do not differ greatly from rates charged those who walk in to borrow over the counter. Banks as a whole appear to be competitive in their loan terms even if not in payments on demand deposits.

On the other hand, a relationship may exist between the general level of rates on loans and the fact that banks need to attract deposits. Loan rates as measured in these tables do not appear to compensate fully for their additional risk of possible losses in comparison with the rate of return on Treasury securities. If they could have obtained the same amounts of funds without having to be in the loan business, banks would have earned as much money with less risk by investing primarily in government securities. As we will note shortly, however, these differences in returns may also reflect the fact that during the entire period lenders and investors were poor forecasters. The anticipated rates of return may have been in accordance with expected risks and returns. Because of large unanticipated movements, the ex post relationships probably do not reflect those lenders held when they decided to lend.

Over this period, despite the fact that loans earned the same as or less than securities, particularly in comparison with risks, banks continually increased the percentage of their loans and decreased the share of government securities in their assets. United States government and agency securities fell from over 25 percent of the total in 1961 to about 13.5 percent by 1975. Loans rose from 45 to 52.5 percent of the total. Whether this shift occurred because there is a significant interrelationship between types of assets and liabilities or simply because rates of return differed

from expectations is not clear. Most bankers assume that if they made fewer loans they would attract fewer depositors.

9.5 Total Returns

The returns discussed thus far are accounting or book returns as reflected in reported balance sheets and income statements. For many purposes, however, we would like to know what happened from year to year in actual or total or market-corrected returns. The return on an asset may be positive or negative. It equals the sum of an interest component plus any change in the present value of future cash flows owing to a shift either in market interest rates or in the observed probability of default.

For an asset traded in an active market such as a listed common stock or bond, the measurement of actual return is simple. We take the dividend or coupon payments received during the year, then add or subtract changes in the market price to get the total return to the asset. If we were able to get the change in market values during the year for each of a bank's assets or classes of assets, we would be able to estimate total returns in this same manner. Unfortunately we cannot. Therefore, to obtain some idea of how risks and returns have varied, we must construct rough approximations of such numbers.

9.5.1 Duration

We have assumed that the market value of each class of assets changes in accordance with the average "duration" of the class multiplied by the change in market yields of government securities of the same approximate duration. These estimates follow from the known general relationship (cf. chap. 13) that the change in price of a bond or loan is equal to the change in expected market interest rates for similar bonds times the negative of its duration, or

$$(3) \quad \frac{d \text{ Price}}{\text{Price}} = \frac{d(1+r)}{(1+r)} \cdot -\text{duration},$$

where r is the rate of interest or yield to maturity (Boquist, Racette, and Schlarbaum 1975). A bond or loan's duration is simply the time until its payments will on average have been received. Thus duration is the average of the present value of each future interest or principal payment times the length of the period until it will be received.

There are well-recognized difficulties with this formulation. No allowances are made for variations in uncertainty or the risk related to the specific asset class. No adjustments are made for changes in the term structure of interest rates. We have not taken into account the fact that some changes in value may have been taken into the books during the

year through the sale or purchase of assets. We have not accounted for changes other than interest rates.

While recognizing that all these factors can affect the value of an asset, we have been forced to work primarily with those changes that result from movements in the basic interest rate. However, it should be noted that changes in defaults and related costs are already reflected in the estimated book returns for that year. Moreover, a number of simulations (cf. chap. 15) of the effect of changes in market values indicates that movements in the interest rate on government securities usually account for most value changes.

As important as these other factors is the lack of exact estimates of the duration of the typical bank's assets. Duration has been estimated in a rough manner from the FDIC reports, Treasury bulletins, and the balance sheets of several large banks. The most that can be claimed is that these estimates probably are in the proper rank order and that the magnitudes are in the ball park. To avoid any sense of undue accuracy, we have rounded the estimated durations to full years. By happenstance, this results in the duration for assets of different types being roughly spaced from one to six years. The assigned duration in years are as follows: consumer loans (1 year); commercial and industrial (2); United States government and agencies (3); nonhome mortgages (4); home mortgages (5); and state and local bonds (6). It is also assumed that rates of return and costs of federal funds, other securities, and purchased money equal the market rates on federal funds and that the duration for these categories is insignificant.

9.5.2 Interest Rate Movements

Changes in interest rates are measured from the end of the year before that for which the rates of return have been estimated to the end of the year covered by the income data. In each case, the rate for the particular yield to maturity is taken from yield curves estimated for the last business day of the year by McCulloch's cubic-spline term structure curve-fitting program for United States Treasuries (McCulloch 1975a).

Table 9.4 shows the estimated changes in capital values for each class of asset. This is in accordance with equation (3). The percentage change in the yield to maturity at the assumed duration for the class of assets is multiplied by the duration of that class.

Table 9.5 is the result of combining the estimated book rates of return in Table 9.1 with the year-to-year change in capital values of table 9.4. Thus it is an estimate of the total return to a class of assets by year. As noted, these may differ from actual changes in values since the durations may not be accurate, since the specific risks of the different classes may have altered, and since changes in the assets held during the year may

Table 9.4 Changes in Capital Values by Class of Assets for Banks, by Years (in Percent per Year)

| Class of Asset or Liability | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|------|-------|------|-------|-------|-------|------|-------|------|------|-------|-------|-------|-------|------|-------|
| <i>Securities</i> | | | | | | | | | | | | | | | | |
| U.S. Treasuries and agencies | .75 | -1.62 | -.84 | -1.11 | -3.12 | -.24 | -.03 | -5.76 | 5.19 | 1.02 | -1.77 | -2.54 | -1.94 | -.22 | 3.99 | -4.80 |
| Federal funds and other securities | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| State and local securities | .98 | -2.27 | -.69 | -2.36 | -4.36 | -2.90 | -.34 | -8.45 | 5.42 | 1.62 | -.68 | -3.39 | -5.11 | -2.34 | 7.62 | -7.74 |
| <i>Loans, net</i> | | | | | | | | | | | | | | | | |
| 1-4 family mortgages | 1.10 | -1.93 | -.72 | -1.97 | -3.78 | -2.28 | -.48 | -7.85 | 5.73 | 1.18 | -.76 | -3.3 | -4.08 | -1.81 | 6.35 | -6.75 |
| Other mortgages | .92 | -1.84 | -.80 | -1.56 | -3.52 | -1.16 | -.32 | -6.73 | 5.72 | 1.16 | -1.48 | -3.00 | -2.96 | -1.04 | 5.40 | -6.04 |
| Commercial, industrial, financial, farm, other loans | .35 | -1.24 | -.70 | -.72 | -2.10 | -.06 | -.16 | -3.52 | 4.46 | .56 | -1.06 | -2.12 | -1.02 | .37 | 2.64 | -3.56 |
| Consumer loans | -.02 | -.69 | -.40 | -.31 | -.97 | -.27 | -.05 | -1.94 | 2.48 | .41 | -.65 | 1.96 | .05 | 1.04 | 1.23 | -2.04 |

Table 9.5 Rates of Total Returns for Classes of Assets for a Sample of Commercial Banks (in Percent per Year)

| Class of Asset or Liability | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 ^a | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|------|------|------|------|-------|------|------|--------------------|-------|------|------|------|------|------|-------|-------|
| <i>Securities</i> | | | | | | | | | | | | | | | | |
| U.S. Treasuries and agencies | 4.18 | 1.88 | 2.93 | 2.75 | 1.18 | 4.30 | 4.54 | -.66 ^a | 10.81 | 6.62 | 3.67 | 2.90 | 4.00 | 5.78 | 10.20 | 1.43 |
| Federal funds and other securities | 2.34 | 3.35 | 2.17 | 2.36 | 3.50 | 4.70 | 3.50 | 4.27 ^a | 5.04 | 4.19 | 4.83 | 7.46 | 9.14 | 6.10 | 5.24 | 4.87 |
| State and local securities | 4.36 | .87 | 2.60 | 1.00 | -1.09 | .79 | 4.50 | -3.85 ^a | 10.45 | 6.20 | 4.07 | 1.40 | .25 | 3.79 | 13.34 | -2.03 |
| <i>Loans, net</i> | | | | | | | | | | | | | | | | |
| 1-4 family mortgages | 4.90 | 2.17 | 3.26 | 2.11 | .78 | 2.33 | 5.25 | -2.75 ^a | 11.17 | 6.87 | 4.73 | 1.90 | 1.59 | 3.76 | 12.73 | -0.53 |
| Other mortgages | 2.87 | 1.59 | 3.21 | 2.16 | .63 | 3.18 | 4.89 | -1.94 ^a | 10.76 | 6.78 | 3.77 | 2.54 | 1.48 | 3.14 | 11.53 | +0.53 |
| Commercial, industrial, financial, farm, other loans | 3.51 | 2.76 | 3.17 | 3.07 | 2.03 | 4.52 | 4.79 | -1.58 ^a | 9.68 | 5.77 | 4.10 | 3.51 | 5.85 | 6.53 | 8.95 | 2.91 |
| Consumer loans | 3.21 | 3.07 | 3.70 | 3.75 | 3.59 | 4.58 | 5.39 | 3.11 ^a | 7.13 | 5.71 | 4.76 | 3.88 | 5.94 | 6.78 | 5.63 | 2.84 |
| <i>Total portfolio of assets and liabilities</i> | | | | | | | | | | | | | | | | |
| Rate on three-month Treasury bills | 2.77 | 3.16 | 3.54 | 3.95 | 4.86 | 4.29 | 5.34 | 6.68 | 6.39 | 4.33 | 4.07 | 7.03 | 7.84 | 5.80 | 4.98 | 5.27 |

| | Means | | Standard Deviations |
|---|---------|---------|------------------------|
| | 1962-77 | 1970-77 | 1962-77 |
| U.S. Treasuries and agencies | 4.19 | 5.30 | 3.15 |
| Federal funds and other securities | 4.59 | 5.86 | 2.17 |
| State and local securities | 2.91 | 4.92 | 4.35 |
| 1-4 family mortgages | 3.79 | 5.28 | 3.96 |
| Other mortgages | 3.57 | 5.06 | 3.58 |
| Commercial, industrial, financial, farm, other loans | 4.35 | 5.91 | 2.89 |
| Consumer loans | 4.56 | 5.33 | 1.73 |
| Rate on three-month Treasury bills | 5.02 | 5.71 | 1.95 |

^aThere are no data for book returns in 1969. The estimates are the average of 1968 and 1970 book returns plus the estimated change in capital values for 1969.

have meant that some of the reported book returns reflected changes in the assets.

The data show that over this entire period economic (as opposed to book) rates of return had a much broader dispersion. Also, using standard deviations as a measure of risk, we find not much relationship between risks and returns. Risk-corrected rates of return did not equalize.

For the period 1970–77, commercial, industrial, farm, and other loans corrected for capital changes did much better relative to other yields and to their book-value estimates. They exceeded, as theory says they should, the rate of return both on more liquid United States Treasuries and on all other activities.

This entire period was dominated by unexpected increases in both long- and short-term interest rates. With only a few exceptions, rates at every maturity rose each year from 1963 through 1969. From that year through 1975, increases were less universal and were decidedly smaller, but yields on all maturities of three years and over were higher in December 1975 than in December 1969 and nearly as high in December 1977.

9.6 Portfolio Rates of Return

A bank's earnings depend upon how each of its assets and liabilities reacts to events, but also upon how each changes as a result of these same events. Disintermediation and a shift in assets might be as significant in threatening insolvency as a loss from interest rate movements. We can consider each of these dangers separately.

We have defined the change in the value of the portfolio caused by changes in the rate of discount applied to the initial expected cash flows from both assets and liabilities as a "wealth effect." Thus, at the end of one year, the value of assets and liabilities and of the bank depends upon the projected cash flows (based upon loan agreements, expected defaults, expected processing costs, etc.) and the discount rates applicable to these future cash flows. During the course of the year, these rates of discount will change as a result of movements in spot interest rates, in forward rates, and the risk premiums for each class of assets and liabilities. Thus the wealth effect depends upon the distribution of assets in the initial portfolio and upon the way each one's rate of discount alters.

The "income effect" on the portfolio's values results from changes in the expected cash flows. These are influenced by movements in the macroeconomy. During the course of the year, cash flows will differ from those expected at the start because market interest rates will apply to new or refinanced loans or investments, because cost of operations will alter, default rates and nonaccruing loans may increase, and the amount of

effort required to collect on loans may differ, and because liquidity problems may lead to transaction costs to liquidate part of the portfolio.

In addition, future cash flows will alter because the amounts of each type of asset and liability in the portfolio may differ. The rate of expansion or decline in holdings of the portfolio will react to movements in interest rates, in the money supply, and in the gross national product and to competitive pressures. How banks react to these movements will differ depending upon such factors as the bank's type of customers, its region, its past commitments, and the way different categories of assets and liabilities react to the economy.

Our study gives rough estimates of these two influences on banks with different weights of assets and liabilities. Our estimates are inexact because in table 9.4 we have not included estimates of shifts in risk premiums or shifts within the term structure, but instead have used the concept of duration and yield to maturity.

9.6.1 Wealth Effects

As examples of wealth effects for an average bank, the losses in capital values as a percentage of its total earning assets were 4.8 percent in 1969, 2.4 percent in 1973, 1.9 percent in 1974, and 4.2 percent in 1977. These are the weighted average of typical portfolios in those years times the rate of loss shown in table 9.4. These losses would have been increased to the extent that risk premiums widened and decreased to the extent that the value of existing deposits rose. However, table 9.1 shows that the cost of deposits rose at about the same rate as the value of money during this period. As a result, since deposits had only a slight influence, we can estimate that in these years the net wealth effect reduced capital values somewhat more than would be estimated from the impact of government interest rates alone.

9.6.2 Income Effects

In contrast to wealth effects, effects on the capital of the average bank from changes in income seem to be small. However, again our data are incomplete. We do not have estimates of shifts in duration from operations, and, as noted earlier, because of changes in the reporting forms we lack information on changes in book income in 1969. What we do have are estimates of changes in value arising from alterations in the mix of assets and liabilities and from movements in book earnings for the other years.

The income effects on a bank's capital value turn out to be rather minor because of offsetting pressures. Earnings on newly purchased rolled-over loans and investments rise, as do costs of liabilities. The chief danger to a bank is likely to be from a need to borrow at much higher rates while the return on assets is moving up more slowly. For the average bank, this

problem was not great. Its costs for demand time and savings deposits rose at roughly the same rate as returns on assets. The costs of purchased money rose rapidly, and their share of total liabilities rose also, but an average bank does not have a large ratio of these liabilities. Table 9.4 shows that, except for a large gain in 1969 and then a sharp fall in 1971, earnings of banks on a book basis did not fluctuate much.

9.6.3 Total Portfolio Earnings

A bank's total return depends on the economic rate of return of each asset and liability and on the amount of each in its portfolio. We estimate the variation in such returns for an archetypal bank by assuming it had a portfolio equal to the mean distribution of assets and liabilities for all banks.

The line in table 9.5 labeled "total portfolio of assets and liabilities" is an estimate of how this typical bank would have fared. From table 9.1 we note rather mild fluctuations in book rates of return on assets, while payments on liabilities moved with market interest rates. When book returns are corrected for changes in capital values, as in table 9.5, except for 1969 most assets showed positive returns.

The picture is nearly, but not quite, the same when the shifting costs of liabilities are added. From the total portfolio line, we note that the typical bank probably lost money on an economic basis in 1969, 1973, 1974, and 1977. But only the first and last of these movements were sufficiently large so that losses were serious. Again, however, the difference between a typical bank and those with very different portfolios could create problem banks.

9.7 Summary

Bank returns from individual activities tend to equalize at the margins. However, equality is far from exact, nor are adjustments rapid. Banks cannot shift their portfolios too suddenly. They have existing commitments to their customers and communities. They can, however, alter their investments more rapidly while slowing down or speeding up lending. The ability of the entire financial system to shift lending plus competition among lenders leads to changes in rates and a tendency for rates among different activities to equalize.

The rate of adjustment of marginal returns is greater on a book basis than on an economic basis. It is simpler for banks to predict book returns. Still, unanticipated losses in a particular class of loan may lead to sizable year-to-year shifts even on a book basis.

The movements in total returns are much sharper. Year-to-year divergences are far greater. In this period, changes in economic returns were dominated by interest rate movements. In the years of maximum

interest increases, most banks lost money. For the entire period, total returns in an activity were negatively correlated with its duration. Since the end of 1969, however, with smaller increases in market interest rates such correlations are less. Returns on commercial, industrial, and related loans have been higher than others in the 1970s.

In contrast to reported book year-to-year earning movements of about 5 basis points, the economic return on net earning assets fluctuated widely. Although exact data are not available for 1969, the shift in returns from 1969 to 1970 was probably over 9 percent. This shift reflects the fact that the three-month Treasury bill rate was 5.92 percent in December 1968, 7.72 percent in December 1969, and 4.86 percent in December 1970. Similarly, from 1976 to 1977 returns fell by nearly 7.75 percent.

While not extreme for the average bank, losses would rise rapidly if a bank maintained a portfolio with a duration far above average. Furthermore, it should be noted that for an average bank the shift in returns from interest rate risks far exceeded variations in defaults or loan losses for even those banks at the high end of the loan loss distribution.

Other significant forces appear to be at work in determining the costs of deposits (net of service charges). Banks' costs of deposits are held down by interest rate ceilings. Even though by law no interest can be paid on demand deposits, their cost is far from zero. Banks that hold deposits gain intangible capital as a result of their profitability. However, no indication exists that significant additional gains or losses arise from interest rate movements. The marginal costs of deposits seem to rise and fall in the same way as returns on assets.

Appendix

We need to differentiate among four separate approaches to estimating costs and revenues of banks.

1. As noted, this study is based upon statistical cost and revenue curves. Reported costs and revenues are regressed on differing amounts of assets and liabilities for each unit in the cross section. The regression coefficients estimate the effect on returns of placing a dollar in one class rather than in another.

Thus the estimated rates of return are closely related to marginal revenue and costs, with the estimated variations in returns depending upon differences among classes. This technique specifically accounts for the interrelationship among the banks' assets and liabilities. The influences of all assets and liabilities are considered simultaneously. One estimates the effect on revenues of placing funds in loans rather than investments in securities while simultaneously considering the effect of such differences on costs. Overhead and partially variable costs are

distributed among assets and liabilities in accordance with the way they cause costs and revenues for classes of assets and liabilities to vary among banks rather than in an arbitrary manner.

2. Closely related to this study are the operating data reported by the FDIC and the Federal Reserve in their annual *Bank Operating Statistics*. Reported data in those publications are unweighted averages of individual banks. This gives a decided bias, because most banks are small while most assets are held by large banks. The sample we used is weighted more heavily to banks with more deposits, but it results in unbiased coefficients. The Federal Reserve–FDIC studies show average costs and revenues for aggregated assets, for specific types of costs, and for gross and net income before and after various types of adjustments. They do not show the interrelationship of costs and revenues. They do not show the net returns for loans or categories of loans. They do not estimate the cost of demand deposits. On the whole, estimates for the few comparable series in this study and *Bank Operating Statistics* are in general agreement. In 1975, however, this study shows a higher return on municipals and lower costs for time and savings deposits. The reason is unclear, but it may be related to the special impact of New York City bonds.

3. Types of data similar to those of the Federal Reserve–FDIC but with more complete breakdowns are found in the annual reports of larger banks. These are the kinds of data used by stock analysts and those in the market concerned with rating the safety of individual banks. Analysis of annual reports tends to emphasize net interest earned or the relationships between rates of interest earned on assets (including the effect of volume and rate changes) and the costs of money available for lending. Payments of interest are estimated for time and savings deposits and for other purchased money. Net interest earned is then compared with the noninterest costs of operating the banks.

4. An entirely different approach is followed by the studies of “functional cost analysis” (FCA) performed by and for Federal Reserve member banks. This approach uses especially prepared detailed cost accounting information. Banks in a sample period report information about personnel and other types of costs assigned to specific functions such as check clearing, account maintenance, and lending. The specific cost functions for four types of loans, for investments, and for types of deposits are estimated. Overhead costs are allocated to each. Gross yields and expenses are then estimated.

To obtain net revenues by class of assets, the FCA studies subtract the average cost of funds from the gross revenue after expenses for a specific class of assets. Similarly, gross revenues after specific expenses are calculated for the entire portfolio, and the average income is credited to each class of liability to get an estimate of net earnings by type of liability and asset.

The basic difference between the cost and revenue data in this study, in contrast to the others, is that the allocations of revenues and costs depend upon the total relationships among classes of assets and liabilities. The estimates are made statistically by regression so that a best estimate is obtained of how costs and revenues vary in accordance with the way sums earned and spent relate to differing distribution of assets and liabilities among the 980 banks in the sample. In almost all cases (the exceptions being noted by asterisks in table 9.1), the resulting estimated coefficients are highly significant (at a 99 percent level).