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Market Interest Rates and Commercial Bank Profitability: An Empirical Investigation

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ABSTRACT

The widespread notion that commercial banks "borrow short and lend long" implies that sharp market interest rate increases may induce a significant number of banking failures. This paper develops a method for estimating average asset and liability maturities for a sample of large money center banks. Regression models are tested to determine if market rate fluctuations have a significant impact on bank profitability. The conclusion is negative: large banks have effectively hedged themselves against market rate risk by assembling asset and liability portfolios with similar average maturities.

THE IMPACT OF MARKET interest rates on commercial bank revenues, costs, and profitability has increasingly concerned economists and policymakers as financial market conditions have become more volatile in recent years. The widespread notion that depository intermediaries "borrow short and lend long" implies that rapid market rate increases may induce an unacceptable number of financial firm failures. Monetary policy discussions have reflected this concern. For many years, the Federal Reserve Board considered stable market rates a goal (or at least an intermediate target) of monetary policy: "The extent to which money market conditions are permitted to fluctuate in the short run is also affected by the unique role of the Federal Reserve System as the Nation's lender of last resort. Liquidity pressures ultimately devolve on the money market and the Federal Reserve has a responsibility for maintaining orderly conditions in that market." (Federal Reserve *Bulletin* (May 1974), page 337).

Since October 1979, historically large short-term rate fluctuations have been accepted by policymakers in their effort to control the monetary aggregates. The banking system's ability to weather these conditions has come as a surprise to many, but seems to indicate that banks have effectively balanced their asset and liability portfolios to hedge against interest rate changes. If so, this phenomenon should be documented. If not, the monetary authority must have estimates of the impact of market rate fluctuations on bank profitability in order to evaluate the trade-off between rate stability and other policy goals. (See Lombra and Struble [10].)

This paper formulates and tests the hypothesis that market rate fluctuations

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adversely affect commercial bank profits. Previous efforts to measure the impact of market rates on banking firms have involved relatively arbitrary assumptions about effective loan and deposit rates and maturities. Section I introduces a more general approach that uses only reported bank data. Regression specifications and data are discussed in Sections II, with empirical results presented in Section III. The paper concludes with a brief summary.

I. Assessing Changes in Intermediary Profitability

In principle, the most straightforward means of evaluating the impact of market rate changes on intermediary welfare is to calculate the net present value effect of an interest rate change. That is, the change in intermediary net worth is the change in existing assets' market value less the change in existing liabilities' market value. Comparing asset and liability "durations" is a related, but more elegant, approach (see Grove [6], Maisel and Jacobson [11], Morrison and Pyle [12]). Empirically, however, the net present value and duration concepts are difficult or impossible to implement. First, some asset and liability durations are ambiguous even in theory. Savings accounts and demand deposits possess short stated maturities, for example, but established customer relationships and depositor's portfolio adjustment costs may make their *effective* maturities much longer. Similarly, explicit or implicit commitments to renew existing loans may raise the effective average loan maturity above that stated in the portfolio. Secondly, detailed data on individual asset and liability account maturities cannot be obtained outside the bank, if they are available at all. As a result, the duration or net present value method requires relatively heroic assumptions in order to be applied by outside analysts.

An Alternative Approach

This paper employs an alternative framework for evaluating the impact of market rates on bank profits, which has the advantage of utilizing only reported bank data. It can be discussed in terms of the simple valuation formula:

$$V = \sum_{t=1}^{\infty} \frac{R_t - C_t}{(1 + i_t)^t} \tag{1}$$

where

V = current market valuation of the firm's equity;
R_t = gross after tax revenues derived by the firm from investment and other activities in period t *exclusive* of capital gains or losses on existing assets and liabilities in the portfolio;
C_t = total after tax costs incurred in period t: interest paid on liablities plus operating costs;
i_t = the discount rate applied by the market in period t.

For reasons discussed below, neither C_t nor R_t should include capital gains or losses on bank assets and liabilities.

Obviously, C_t, R_t, and i_t are significantly affected by market rate conditions,

and the balance among them determines the net impact on bank market value. Samuelson [13] first noted the two distinct (though related) channels through which money market conditions can affect valuation as given by (1).[1]

1. *The Market Discount Rate*

A bank holding multiperiod, fixed rate assets (liabilities) will find that $R_t(C_t)$ responds less to a change in the market rate than the discount rate (present or future) does. Even if the bank were perfectly hedged in the sense that its net revenue is independent of the market rate, the profit stream's present value changes with the discount rate. This effect is unlikely to precipitate failure if the firm's initial market value had been positive.

2. *The Bank's "Profit Margin"*

The "borrow short and lend long" view of intermediaries suggests a sharp market rate increase will raise C_t above R_t for some time. Market value (1) could become negative, or the intermediary could fail from insolvency despite a positive market value.[2] Cost and revenue streams could respond differently for either of two reasons. First, the average maturities (duration) of the asset and liability portfolios could differ. As an extreme, consider a bank holding only consols and financed entirely with overnight liabilities which bear the market rate. A permanent increase in interest rates raises all interest components of C_t commensurately, while all R_t remain unchanged. Intermediary owners are obviously worse off and the firm would fail following a large enough increase in market rates. Secondly, suppose the bank's assets and liabilities possess similar durations. R_t and C_t may still respond differently to a market rate change if depositors and borrowers have different elasticities of substitution between bank securities and open market securities. That is, intermediaries' market power in loan and deposit markets may change by different amounts when the market rate changes.[3] This possibility is implicitly included in the empirical approach employed here.

3. *Market Conditions and Bank Profits*

Empirical estimates of the (short run and long run) responses of nominal revenues and costs to market rates can be combined with (1) to make inferences about intermediary welfare. Two distinct aspects of market rate conditions may affect bank revenue and costs in (1): the *level* of interest rates and the *variability* (predictability) of rates around their average level within each period. These can be discussed separately.

[1] A third effect, a change in bank leverage induced by interest rate changes, is ignored here but discussed briefly in the conclusion.

[2] Failure due to insolvency requires some imperfection in the market for deposits or interbank loans. Yet bankers and regulators do seem concerned that such imperfections exist, and "lender of last resort" powers are intended in part to avoid such failures.

[3] Equivalently, one can say that the cross-elasticity between deposits and the market rate reflects savers' valuation of the intermediation services provided in conjunction with deposit balances. If demand for these services varies with market rates, so too will profit. Of course, intermediary market power may be nonexistent at any market rate level.

In general equilibrium, bank customers choose between intermediated and nonintermediated securities. Some bank assets and liabilities are indistinguishable from "market" securities—negotiable certificates of deposit, federal funds, investment securities, perhaps even the loans and demand deposits of Fortune 500 corporations—and the bank's return on (cost of) these assets (liabilities) would fluctuate closely with other market rates. But a substantial proportion of banking activities involves small investors and borrowers. Differential information and transaction costs or corner solutions in these investors' portfolio allocations make them unable to respond fully to a change in the level of market rates. Because of such retail customers, bank profit margins can vary with the level of market rates. Noncompetitive profit rates persist in the long run only if regulators provide entry and/or exit barriers to local banking markets.

In theory, the level of intermediaries' long run reported revenue and/or costs could also depend on interest rate variability. A ceteris paribus increase (for example) in market rate variability has two potential effects on financial intermediary firms. First, firms with a comparative advantage in securities trading would tend to benefit at the expense of less informed (talented) traders in the market. Such bank profits are reported separately. Secondly, the public's demand for intermediated securities—deposits and/or loans—might depend on the degree of uncertainty in primary security markets. Tobin's [16] well-known liquidity preference argument suggests this possibility for fixed-rate deposits, and Benjamin Klein [9] claims the public's demand for medium of exchange varies with price level uncertainty (which tends to be reflected in nominal interest rate fluctuations). On the loan side, the demand for fixed rate intermediary loans might be expected to increase with higher market rate variability.[4]

II. Data and Regression Models

Separate estimates of the relation between market conditions and bank revenues and costs may be combined with (1) above to assess the overall impact of rate fluctuations on intermediary firms' profitability. The central empirical issue is how large and long-lasting are the market rate effects on intermediary revenue and cost streams.

The Data

The relation between market conditions and intermediary profitability was explored empirically using annual Compustat data on large banking organizations. The Compustat bank tape includes 135 banking firms, but only about thirty report complete data for the sample period 1959–78. The fifteen firms listed in Table I were selected randomly from this group of thirty.[5] The average sample bank held assets of $35 billion at year end 1978, with individual banks ranging from $2.5 billion to $94.9 billion. Accounting data such as these are notoriously subject to smoothing and other biases, but there is no alternative for the purpose

[4] If customers are more averse than banks to rate variability, the intermediary would write more interest rate insurance in the form of fixed rate loans.

[5] Most of these data are for bank holding companies, but the bank subsidiaries account for the vast majority of these holding companies' activities.

Table 1

Sample Banking Firms

1.	Chase Manhattan Corporation
2.	Citicorp
3.	Irving Bank Corporation
4.	CBT Corporation
5.	Marine Midland Bank
6.	First Atlanta Corporation
7.	Southeast Banking Corporation
8.	Detroit Bank Corporation
9.	Manufacturers National Corporation
10.	Pittsburgh National Corporation
11.	Valley National Bank of Arizona
12.	Bancal Tri-State Corporation
13.	Bankamerica Corporation
14.	Seafirst Corporation
15.	Security Pacific Corporation

at hand. Income smoothing adjustments should affect long run coefficient estimates less than short run and, fortunately, much of the discussion below concerns the former.

The revenue variable R_t in (1) should include net interest income from loans and securities plus fee income on services sold. All these items are contained in "gross operating income" reported by Compustat. Though it is tempting to include capital gains or losses on outstanding assets and liabilities in R_t, this would amount to double-counting and should be avoided. (In addition, of course, data on market value changes are largely unavailable.) Consider the impact of an increase (say) in market rates on the value of a fixed rate asset. The constancy of nominal returns relative to the discount rate *causes* the capital loss; subtracting that loss from interest income in (1) and discounting once again would double-count the impact of market rates on the asset's value.[6]

Bank costs (C_t) can be represented by total operating expenses (TOE)—interest paid plus all noninterest costs. Net current operating earnings (NCOE) is the difference between GOI and TOE, net of taxes. Adjusting NCOE for the after tax impact of realized securities gains or losses and other extraordinary items finally yields net income (NI).

Relevant money market rates were summarized by weekly observations on the federal funds rate, the (coupon equivalent) yield on 12 month treasury bills, and the market rate on three-year-to-five-year government bonds.[7] The rate level for

[6] If gains or losses are *realized* by the bank, the situation becomes more complex. Suppose the firm liquidates some fixed rate assets following a market rate increase. At current market prices, it can buy fewer new securities, each of which provides a higher yield. Except for tax implications, the effect on R_t of realizing these losses is nil, but bank total assets would decline, raising the average return on bank assets. Econometric estimates of the asset portfolio's average maturity will therefore be biased downward by realized capital gains or losses. Since the majority of bank assets are effectively nonmarketable and banks tend to avoid realizing capital value changes on their investment portfolios, this realization effect was small: over the sample period, the average bank's absolute value of realized capital gains or losses averaged .064% of total assets.

[7] In addition to these three, an expected forward rate was calculated from the bond rate and the bill rate. Using this rate instead of contemporaneous interest rates in Regressions (3), (4), and (5)

each year (measured in percentage points) was the simple average of 52 weekly rates.[8] Three alternate variability measures were constructed for each interest rate: (1) the standard deviation of weekly rates around their annual average; (2) the range (highest minus the lowest observation) of weekly rates within each year, excluding the five highest and five lowest rates; and (3) the standard error from regressing each week's rate on the lagged rate and a constant.

Variability measures were only occasionally significant in regressions (3), (4), or (5) below and were therefore dropped from the final specifications (reported in Table II) to obtain more efficient estimates. The irrelevance of intraperiod rate variability constitutes an important conclusion of this study.

Partial Adjustment Specifications

Were the intermediary allocating investable funds without limitations imposed by past portfolio decisions, optimal asset choices would yield a nominal flow of revenues

$$\text{GOI}^* = f(r, \sigma^2, \text{TA}) \tag{2}$$

where

TA = book total assets

r = level of the market interest rate

σ^2 = variability of the market interest rate

(This expression (2) obviously summarizes a considerable amount of intermediary and customer optimizing behavior.) In reality, banks can allocate only a portion of their earning assets in the short run, meaning that nominal bank revenue will adjust to (2) with a lag.[9] A regression specification describing this lagged adjustment should differentiate between the return on net new earning assets (which should fully reflect current market rates) and the gradual reinvestment of previously allocated assets whose nominal returns reflect past market conditions.

The Appendix derives (3) as the proper specification for such an adjustment process:

$$\frac{\text{GOI}_t}{\text{TA}_{t-1}} = \alpha_0 + \alpha_1 \left(\frac{\text{GOI}}{\text{TA}}\right)_{t-1} + \alpha_2 r_t + \alpha_3 \sigma_t^2 + \alpha_4 \left[r_t \left(\frac{\text{TA}_t - \text{TA}_{t-1}}{\text{TA}_{t-1}} \right) \right] + \hat{\epsilon}_t \tag{3}$$

resulted in considerably larger standard errors but little change in estimated interest elasticities or adjustments speeds.

[8] This study employs only historical market rate data, but the distinction between anticipated and unanticipated rate fluctuations could prove important in evaluating the interest rate risk exposure of individual banks. If ex post interest rates have no significant effect on reported bank profits, it follows that banks have effectively hedged themselves against interest rate risk. On the other hand, finding a positive or negative relation between market rates and bank profits implies nothing about the bank's risk exposure in the absence of evidence on the extent to which rate changes are anticipated ex ante. See Swan [14].

[9] A bank could adjust its revenue to (2) instantaneously if it liquidated all its old assets whenever

The expected coefficient signs are[10]:

$$\alpha_0, \alpha_2, \alpha_4 > 0$$

$$0 \leqslant \alpha_1 \leqslant 1$$

$$\alpha_3 \gtrless 0.$$

The asset portfolio's estimated speed of adjustment is $(1 - \alpha_1)$, which implies a mean lag corresponding to the portfolio's average maturity of $[\alpha_1/(1 - \alpha_1)]$. The reasonableness of this coefficient estimate constitutes one check on the specification (3).

Rate ceilings have forced banks to compete for some types of deposit accounts largely through implicit interest payments, making it necessary to combine interest and selected noninterest expenses to estimate average liability costs. For reasons similar to those affecting GOI, total operating expenses (TOE) also adjust to current market rates slowly over time. The regression form estimated for total operating expenses is therefore analogous to (3):

$$\frac{\text{TOE}_t}{\text{TA}_{t-1}} = \beta_0 + \beta_1 \left(\frac{\text{TOE}}{\text{TA}}\right)_{t-1} + \beta_2 r_t + \beta_3 \sigma_t^2 + \beta_4 \left[r_t \left(\frac{\text{TA}_t - \text{TA}_{t-1}}{\text{TA}_{t-1}} \right) \right] + \hat{\mu}_t \tag{4}$$

The coefficients' expected signs and interpretations are also analogous to those for regression (3).

Finally, a similar partial adjustment relationship was estimated for net current operating earnings (NCOE):

$$\frac{\text{NCOE}_t}{\text{TA}_{t-1}} = \gamma_0 + \gamma_1 \left(\frac{\text{NCOE}}{\text{TA}}\right)_{t-1} + \gamma_2 r_t + \gamma_3 \sigma_t^2 + \gamma_4 \left[r_t \left(\frac{\text{TA}_t - \text{TA}_{t-1}}{\text{TA}} \right) \right] + \hat{v}_t \tag{5}$$

NCOE is a more appropriate measure of bank income than net income (NI) in the present context: extraordinary income items and realized securities gains or losses are often tax related in their timing, obscuring the impact of market rate changes on true bank welfare.

These regression specifications exhibit two important characteristics. First, the adjustment speeds in (3), (4), and (5) are constrained to be constant through time, while institutional innovations and/or bank responses to increasing uncertainty might have caused them to increase later in the period 1959–78. Two independent tests were performed to confirm the constancy of adjustment speeds.

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market rates change. There is no particular advantage in such behavior (and some disadvantages—for example, capital adequacy regulation makes bankers reluctant to book sizable capital losses). Furthermore, many bank assets are effectively nonmarketable.

[10] Since the average increment to investable assets is approximately $[\frac{1}{2}(TA_t - TA_{t-1})]$, α_4 should be less than 0.5 by the proportion of nonearning assets held at the margin. However, a seasonal pattern to asset growth would make $[\frac{1}{2}(TA_t - TA_{t-1})]$ a biased estimate of average new assets, tending to either raise or lower α_4.

1. The adjustment speed was specified as dependent on financial market uncertainty:

$$\left(\frac{\text{GOI}}{\text{TA}}\right)_t = \delta_0 + (\delta_1 + \delta_2\sigma_{rt}^2)\left(\frac{\text{GOI}}{\text{TA}}\right)_{t-1} + \delta_3 r_t + \hat{\omega}_t$$

with similar specifications for (TOE/TA and NCOE/TA). The coefficients on σ_{rt}^2 were rarely significant.

2. The estimation period was divided at the midpoint and an F-test performed for the hypothesis that all coefficients remained unchanged during the period. Stable coefficients were indicated (at the 95-percent confidence level) for 39 of the 45 regressions, indicating the general absence of structural shifts within the estimation period.[11]

Secondly, the specifications are linear. Since some revenues and costs (trust income, fixed operating costs, securities brokerage fees, etc.) are insensitive to market rates, a log-linear functional form (which imposes a constant elasticity between market rates and costs or revenues) would be inappropriate. The constant terms in (3), (4), and (5) should capture the fixed components of costs and revenue. The magnitude of these constant terms reported in Table I indicates that these income and cost elements are small (at least on net).

Estimation Methods

The combination of a lagged dependent variable with autocorrelated disturbances would bias coefficient estimates, especially the speed of adjustment. Moreover, Durbin's h-statistic test for autocorrelation has unknown properties in small samples. Rather than take the chance of spuriously accepting the hypothesis of no serial correlation, regressions (3) through (5) were estimated with an iterative Cochrane-Orcutt correction. Judging from the resulting h-statistics, most banks' regressions have no serial correlation and the coefficient estimates can be considered unbiased.

Since some (common) unobservable explanatory variables are undoubtedly omitted from (3), (4), and (5), the regressions' disturbance terms are likely to be correlated. Zellner's technique for seemingly unrelated regressions was therefore applied to estimate TOE, GOI, and NCOE jointly for each bank. The resulting standard errors are considerably smaller than those produced by OLS.

Finally, GOI includes some tax exempt interest income which is not directly comparable with the expenditures in TOE. (GOI/TA) must therefore be converted to a tax equivalent basis by removing fifty percent (the approximate marginal corporate tax rate) of state and local securities (SL) from TA.[12] The dependent variable in (4) becomes $[\text{GOI}_t//\text{TA}_{t-1} - 0.5\text{SL}_{t-1})]$, which behaves as a fully taxable rate of return. The interest rate coefficients can then be directly compared across regression (3), (4), and (5).

[11] Bank number 13 showed critical F-values for all three regressions. Other critical values were the NCOE regression for Bank 3 and the TOE regressions for Banks 4 and 7.

[12] An alternative adjustment would double the tax exempt income in GOI, leaving the scale variable unchanged. This method was rejected because the income data were poorly reported early in the period.

III. Empirical Results: The Impact of Market Rate Changes

Table II reports regression results for each bank's revenue, costs, and net current operating earnings with the "market rate" represented by the 12 month treasury bill rate. (Results for a shorter (federal funds) or longer (government bond) rate show similar long-run interest coefficients on GOI, TOE, and NCOE.) The fits are good and autocorrelation is absent for the most part.

As noted above, duration and net present value analyses suffer from their inability to estimate the maturity (duration) of passbooks, demand deposits, and the like. Here the estimated speed of adjustment implies a mean lag which can be interpreted as the bank's average asset or liability maturity. For example, the average asset adjustment speed $(1 - \alpha_1)$ of sample banks is .442, corresponding to a mean lag of 1.26 years. The sample's average liability adjustment coefficient $(1 - \beta_1)$ is .356, implying an average maturity of 1.81 years. Contrary to the conventional wisdom, these estimates indicate that large banks tend to borrow *long* and lend *short*, though the maturity differences are not large. At least on average, large banks appear to have hedged their balance sheets quite well.[13]

A change in market rates could make bank earnings in (1) negative either permanently (inducing failure) or temporarily. In the latter case, the bank might fail from a liquidity crisis or because its losses, though temporary, are sizable enough to make its market value negative. Table III uses the coefficient estimates reported above to test several hypotheses about the impact of market rate changes on bank profits.

The first column in Table III reports the difference between each bank's asset and liability adjustment speeds. Each difference is negative, indicating (again) that the sample banks borrow for longer average term than they lend. The implied average asset and liability maturities differ significantly for nine of the fifteen banks. The second column contains the contemporaneous impact of a market rate change on the spread between revenue and costs (as a proportion of total assets). Six banks manifest a statistically significant difference here, with revenue more responsive to the market rate in five cases.

The third and fourth columns of Table III summarize the long run effects of a permanent market rate change on the (tax equivalent) interest margin and on net current operating earnings. Only four banks' long run interest margins are significantly affected by a market rate change. Adjusting for taxes, NCOE shows a significant long run effect at only two banks. To provide a context for assessing the magnitude of these long run effects, the last two columns contain the sample period's average interest margin (defined as [GOI/(TA-0.5SL)—TOE/TA] and average (NCOE/TA) for each bank.

The evidence in Table III indicates that large banks as a group have been surprisingly well-hedged against market rate fluctuations. Market rates have no statistically significant long-run impact on NCOE for thirteen of the sample's

[13] An intermediary can be considered "hedged" against market rate fluctuations in either of two distinct senses: if its cash flow does not change (which is what large banks have apparently done), or if its market value does not change. Hedging simultaneously in both senses is impossible. See Bierwag, Kaufman, and Toeves [1].

Table II

Bank Revenue, Costs, and Net Operating Income as Functions of the Market Interest Rate*

Bank Number		Return on New Assets	Lagged Dep. Var.	Treasury Bill Rate	$\hat{\rho}$	Constant	h-statistic	$\bar{R}^2$	Mean of the Dep. Var.	Long Run Interest Rate Coefficient
1.	GOI	.565	.651	.487	.132	.575E-2	−.258	.844	.0571	1.39
		(2.44)	(6.28)	(3.74)	(.702)	(.346)				(3.42)
	TOE	.567	.704	.468	.104	−.0107	−.170	.881	.0465	1.58
		(2.44)	(7.60)	(3.67)	(.556)	(1.82)				(3.49)
	NCOE	.027	1.05	.427E-2	−.071	−.42E-3	1.32	.815	.00568	−.0789
		(.789)	(8.40)	(.346)	(.308)	(.356)				(.430)
2.	GOI	.996	.757	.456	.0273	−.0100	−.082	.923	.0633	1.88
		(3.45)	(8.18)	(3.27)	(.220)	(1.75)				(2.90)
	TOE	.976	.770	.426	−.312E-3	−.0125	.014	.938	.0510	1.85
		(3.72)	(9.55)	(3.38)	(.311E-2)	(2.53)				(3.19)
	NCOE	.0385	.402	−.0155	.0190	.498E-2	a.	.558	.00697	−.0259
		(1.65)	(1.43)	(1.12)	(.235)	(2.17)				(1.59)
3.	GOI	.382	.329	.644	.268	.303E-3	.824	.901	.0545	.960
		(2.50)	(3.29)	(7.22)	(1.88)	(.0576)				(6.63)
	TOE	.348	.394	.659	.175	−.915E-2	.981	.917	.0450	1.09
		(2.23)	(4.42)	(7.18)	(1.22)	(2.18)				(7.59)
	NCOE	.0404	.877	−.450E-2	−.349	.867E-3	1.27	.869	.00514	−.0366
		(2.40)	(5.55)	(.352)	(1.38)	(1.88)				(.549)
4.	GOI	.193	.580	.480	.198	.656E-2	−.037	.926	.0704	1.14
		(1.41)	(7.75)	(7.74)	(.994)	(1.54)				(6.27)
	TOE	.223	.756	.410	.327	−.538E-2	.123	.949	.0538	1.68
		(1.81)	(10.53)	(6.13)	(1.62)	(1.36)				(3.81)
	NCOE	−.0464	1.16	.0204	.250	−.166E-2	.220	.852	.00815	−.124
		(1.37)	(7.13)	(1.33)	(.903)	(.903)				(1.25)
5.	GOI	.161	−.0264	.514	.614	.0380	−.085	.893	.0654	.500
		(1.21)	(.251)	(8.70)	(4.58)	(5.05)				(6.90)
	TOE	.167	.0363	.484	.820	.0303	.100	.922	.0545	.502
		(1.03)	(.273)	(6.62)	(9.53)	(2.57)				(4.77)

	NCOE	.0794	.989	−.0173	−.326	.818E-3	1.71	.932	.00546	−1.51
		(1.94)	(7.45)	(.947)	(.687)	(.541)				(.0920)
6.	GOI	1.303	.879	.489	.968	−.061	.078	.982	.0703	4.06
		(12.19)	(6.40)	(8.35)	(9.10)	(.411)				(.842)
	TOE	1.355	1.08	.615	1.00	−6.70	1.14	.986	.0579	b.
		(11.70)	(8.13)	(11.24)	(19.4)	(.0064)				
	NCOE	.0926	.562	−.0408	.406	.0049	a.	.754	.00672	−.0933
		(3.59)	(1.86)	(2.65)	(1.01)	(9.10)				(1.70)
7.	GOI	1.07	.770	.341	−.174	−.352E-2	−.211	.936	.0678	1.48
		(5.64)	(9.25)	(3.32)	(.839)	(.951)				(3.64)
	TOE	.882	.844	.284	−.107	−.675E-2	−.488	.942	.0534	1.82
		(4.70)	(11.0)	(2.76)	(.536)	(1.90)				(2.86)
	NCOE	.0678	.479	.0181	.714	.299E-2	a.	.685	.00790	.0348
		(1.01)	(.723)	(.637)	(1.67)	(.630)				(.462)
8.	GOI	.535	.599	.383	−.0416	.622E-2	.327	.911	.0650	.957
		(2.38)	(7.37)	(6.66)	(.192)	(1.61)				(5.79)
	TOE	.416	.690	.270	−.201	.194E-2	−1.31	.892	.0485	.872
		(1.65)	(8.03)	(4.80)	(.999)	(.732)				(4.63)
	NCOE	.0706	.246	.0406	.535	.398E-2	−1.82	.651	.00876	.0537
		(2.13)	(1.48)	(3.51)	(3.18)	(2.53)				(2.73)
9.	GOI	.652	.585	.362	.0782	.602E-2	.275	.934	.0612	.871
		(3.99)	(7.93)	(6.52)	(.431)	(1.72)				(6.41)
	TOE	.550	.649	.289	−.0677	.245E-2	.223	.931	.0495	.821
		(3.49)	(9.20)	(5.32)	(.387)	(.966)				(6.20)
	NCOE	.0688	.277	.0269	.558	.300E-2	a.	.632	.00669	.0372
		(2.02)	(1.10)	(1.91)	(2.61)	(1.68)				(1.52)
10.	GOI	.722	.622	.317	−.385	.853E-2	.096	.956	.0680	.838
		(4.62)	(10.83)	(6.61)	(1.83)	(3.39)				(7.61)
	TOE	.842	.738	.200	−.414	.189E-2	.353	.944	.0502	.764
		(5.12)	(12.65)	(3.95)	(2.06)	(.986)				(4.97)
	NCOE	.904E-3	.426	.0436	.536	.359E-2	2.81	.837	.0100	.0759
		(.0288)	(2.10)	(3.36)	(1.94)	(1.81)				(2.14)

[a] h-statistic unavailable.

[b] Meaningless statistic because $\hat{\beta}_1 > 1$.

* Numbers in parentheses are t-statistics.

Critical values at 95% confidence level, one-tailed test: $t > 1.761$, $|h| > 1.654$.

Table II—*Continued*

Bank Number		Return on New Assets	Lagged Dep. Var.	Treasury Bill Rate	$\hat{\rho}$	Constant	h-statistic	$\bar{R}^2$	Mean of the Dep. Var.	Long Run Interest Rate Coefficient
11.	GOI	.551	.437	.369	−.0499	.0204	−.212	.938	.0721	.655
		(3.66)	(5.55)	(8.09)	(.250)	(5.57)				(9.07)
	TOE	.296	.582	.324	−.594E-2	.863E-2	−.151	.946	.0579	.774
		(2.01)	(8.27)	(6.69)	(.0305)	(3.28)				(7.56)
	NCOE	.0827	−.0880	.0254	.779	.566E-2	a.	.553	.00744	.0234
		(2.40)	(.352)	(1.92)	(6.30)	(3.19)				(1.75)
12.	GOI	.473	.495	.433	−.144	.0105	−.736	.879	.0660	.858
		(2.16)	(7.09)	(6.53)	(.865)	(2.73)				(7.79)
	TOE	.566	.530	.461	−.102	.227E-2	−.699	.934	.0577	.982
		(2.93)	(7.45)	(6.77)	(.543)	(.739)				(9.25)
	NCOE	−.0834	.729	−.0191	−.322	.284E-2	.443	.178	.00430	−.0704
		(1.10)	(3.55)	(.876)	(1.20)	(1.47)				(1.18)
13.	GOI	.549E-3	.621	.390	.413	.613E-2	−.258	.765	.0596	1.028
		(.204E-2)	(5.31)	(3.54)	(2.36)	(.718)				(2.24)
	TOE	.0302	.702	.348	.302	−.381E-3	−.215	.829	.0471	1.169
		(.105)	(7.36)	(3.32)	(1.75)	(.0664)				(2.39)
	NCOE	.757E-2	.691	.584E-2	.309	.188E-2	a.	.787	.00618	.0189
		(.199)	(2.28)	(.446)	(.645)	(.894)				(.346)
14.	GOI	.862	.540	.415	−.184	.857E-2	.790	.977	.0710	.900
		(8.33)	(10.41)	(8.47)	(1.05)	(3.89)				(10.79)
	TOE	.886	.618	.362	−.0745	−.393E-3	.833	.969	.0548	.946
		(6.90)	(10.65)	(5.91)	(.425)	(.176)				(7.58)
	NCOE	.0108	.863	.738E-2	−.643	.133E-2	1.32	.602	.00854	.0539
		(.442)	(6.47)	(.884)	(2.37)	(1.01)				(.536)
15.	GOI	1.23	.536	.408	.647	.583E-2	−.754	.947	.0694	.880
		(10.04)	(8.35)	(6.62)	(5.72)	(1.02)				(5.06)
	TOE	1.16	.572	.363	.434	.572E-3	−.526	.922	.0556	.849
		(6.69)	(7.38)	(4.37)	(3.00)	(.122)				(4.69)
	NCOE	−.0187	.745	.0138	.512	.147E-2	a.	.811	.00677	.0540
		(.504)	(1.93)	(.941)	(1.06)	(.522)				(.449)

Table III

Revenue and Cost Interest Sensitivity[+]

Bank Number	$(\alpha_1 - \beta_1)$	$(\alpha_2 - \beta_2)$	$\left[\frac{\alpha_2}{1-\alpha_1} - \frac{\beta_2}{1-\beta_1}\right]$	$\frac{\gamma_2}{1-\gamma_1}$	Average Interest Margin	Average NCOE/TA
1.	−.053*	.019	−.186*	−.0789	1.25	.57
	(3.08)	(1.05)	(2.49)	(.430)		
2.	−.013	.030	.024	−.0259	1.24	.70
	(.670)	(1.04)	(.188)	(1.59)		
3.	−.064*	−.015	−.126*	−.0366	.95	.51
	(2.20)	(.653)	(3.79)	(.549)		
4.	−.175*	.0697*	−.535*	−.124	1.66	.82
	(4.62)	(2.30)	(1.82)	(1.25)		
5.	−.063	.030	−.0017	−1.51	1.09	.55
	(.928)	(.888)	(.030)	(.092)		
6.	−.202*	−.126*	a.	−.0933	1.24	.67
	(1.97)	(2.91)		(1.70)		
7.	−.074	.057	−.338	.0348	1.44	.79
	(1.69)	(1.04)	(.913)	(.462)		
8.	−.090	.113	.085	.0537*	1.65	.88
	(.748)	(1.69)	(1.05)	(2.73)		
9.	−.064*	.073*	.049	.0372	1.17	.67
	(2.53)	(3.89)	(1.27)	(1.52)		
10.	−.116*	.117*	.074	.0759*	1.78	1.01
	(2.90)	(3.47)	(.786)	(2.14)		
11.	−.145*	.045	−.119	.0234	1.42	.74
	(2.61)	(1.25)	(1.62)	(1.25)		
12.	−.035	−.028	−.124*	−.0704	.83	.43
	(1.10)	(.739)	(1.89)	(1.18)		
13.	−.082*	.042*	−.140	.0189	1.25	.62
	(1.87)	(2.01)	(1.23)	(.346)		
14.	−.078*	.053*	−.045	.0539	1.62	.85
	(4.44)	(2.50)	(.826)	(.536)		
15.	−.035	.045	.031	.0540	1.38	.68
	(.728)	(1.47)	(.397)	(.449)		

Coefficients in the column headings refer to regressions (3), (4), and (5):

$(\alpha_1 - \beta_1)$: Difference between the lag coefficients on revenue vs. costs.

$(\alpha_2 - \beta_2)$: Difference between the short-run interest coefficients on revenue vs. costs.

$\left[\frac{\alpha_2}{1-\alpha_1} - \frac{\beta_2}{1-\beta_1}\right]$: Difference between the long-run interest coefficients on revenue vs costs.

$[\gamma_2/(1-\gamma_1)]$: Long-run interest coefficient on (NCOE/TA).

[+] Numbers in parentheses are *t*-statistics.

* Significantly different from zero at 95% confidence level, one-tailed test ($t > 1.761$).

[a] Meaningless statistic because $\hat{\beta}_1 > 1$.

fifteen banks. The remaining two banks both experience *higher* net earnings when market rates rise. Significance levels aside, the magnitude of these effects are small compared to the average net return on assets: ignoring signs, a permanent 100 basis point change in the treasury bill rate changes (NCOE/TA) by only

5.6% for the average bank.[14] (Since some banks gain and some lose for any rate change, the *net* effect on sample banks as a group is considerably smaller: −.54%) Before taxes, the long-run effects of market rates on revenue and costs differ significantly for only four of the fifteen sample banks but in all cases tax effects reduce the net impact of a change in interest margins on NCOE. With few exceptions the impact of any reasonable market rate change on bank earnings is small compared to average interest rate margins.

Despite these sanguine long run results, bank failures could conceivably occur if market rate fluctuations cause large negative cash flows in the short run. To evaluate this possibility, estimated values for α_1, α_2, β_1, and β_2 were used to calculate the adjustment path of each bank's interest margin [GOI/(TA-0.5SL) − TOE/TA] following an assumed permanent change in the market rate. In each case, the interest margin approaches its long run value monotonically and no bank experiences any single-period change in its interest rate margin greater than 40% of the long-run effect. In sum, the long run results reported in Table III accurately reflect the effect of market rates on bank profitability.

These results are strong and uniform for large banking organizations: reported profits generally fluctuate little when market rates change. Contrary to the conventional wisdom, bank failures from negative cash flows are unlikely even if market rates rise sharply.[15] Moreover, this conclusion is robust. Different regression specifications and interest rate variables uniformly yield the same empirical results.

IV. Conclusion

This paper has argued that intermediary welfare must be measured by evaluating a formula like (1). The responses of R_t and C_t to market rate changes then determine whether regulators should take pains to stabilize market conditions. Market rate levels emerge as a prominent influence on intermediary costs and revenues, but the effects of market rate changes effectively cancel one another for most large banks. Furthermore, intraperiod rate variability around a fixed mean has no significant effect on bank revenues or costs. In view of the uncertainties associated with describing the duration of bank demand deposits, savings accounts, and so forth, this ex-post performance by large banks must be considered rather impressive. Regulatory authorities can take heart from the fact that large banks as a group are not seriously endangered by market rate fluctuations,

[14] This calculation omits Bank 5, whose speed of adjustment for NCOE is insignificantly different from unity. The large negative long run coefficient on NCOE therefore seems spurious.

[15] A potential caveat arises because these conclusions derive from accounting data, which can sometimes be manipulated to smooth reported earnings. As a worst case, suppose that the sample banks were maturity mismatched and artificial smoothing is entirely responsible for the absence of year-to-year income fluctuations in the data. Even so, if accountants only smooth the actual profits (as opposed to *manufacturing* reported profits), the impact of market rates on true profits must net out to zero within several years in order to avoid any empirical relation between rates and profitability. At a minimum, therefore, the empirical results reported here imply unambiguously that bank income fluctuations due to market rate changes are quite small *relative to* the average level of reported income.

at least within the historically relevant range. (Zwick [17] reaches a similar conclusion for government securities dealers.[16])

Several important questions remain for future research. First, the analysis presented here ignores bank earnings risk and thus cannot determine the net effect of market rates on bank equity values relative to equity values of other firms. Regression results indicate that (NCOE/TA) remains approximately constant when the market discount rate rises. If bank leverage is also unchanged, the nominal return on equity remains constant and market value declines. If, instead, leverage changes with market rates, both the expected return on equity and its riskiness will be affected. Without a complete model of capital market equilibrium, no further statements can be made about shareholder welfare. Another effect on bank market value occurs if market rates affect the *riskiness* of bank earnings. (For example, loan losses may become less predictable with higher nominal rates.) Equity values would decline as bank returns become more risky, but the empirical analysis employed here would not capture this effect.[17]

Secondly, it is unclear how banks operationally achieve maturity balance, though this is a major management issue. Some information may be obtained by cross-section regressions of individual bank interest rate responses on their average asset and liability compositions. Such an effort might eventually provide regulators with a means of monitoring the maturity risk exposure of individual commercial banks. Finally, the methodology developed here should be extended to thrift institutions and small banks. Since these institutions have access to a smaller set of financial instruments than large money center banks, their reaction to market rate fluctuations could differ substantially. This work is in progress.

APPENDIX

Derivation of Regression Specification (3)

Total nominal revenues can be written

$$GOI_t = g\{r_t, \sigma_t^2, (TA_t - TA_{t-1})] + GOI_t^+ \tag{A.1}$$

The first component represents the return on net new assets, which should fully reflect current market rates. The portfolio of "old" assets (TA_{t-1}) earns GOI_t^+ this period, reflecting current market rates only to the extent some old assets have matured and been reinvested. Assuming that a linear form of (2) describes the target return on old assets

$$GOI^* = [w_0 + w_1 r_t + w_2 \sigma_t^2] TA_{t-1} \tag{A.2}$$

[16] It should be emphasized again that the empirical work presented here makes no allowance for intermediary firm riskiness. Money market conditions may prominently affect the riskiness of intermediary profit streams, swamping the effects described above. This possibility remains an unexplored empirical issue.

[17] A recent study by Chance and Lane [4] specifically addresses the relation between market rates and financial firm equity values. (Bank holding companies constitute one distinct subsample in their study.) They conclude that interest rate changes do not affect the value of financial firms relative to the market portfolio.

and approximating the adjustment of GOI_t^+ to GOI_t^* with

$$[GOI_t^+ - GOI_{t-1}] = \lambda[GOI_t^* - GOI_{t-1}] \tag{A.3}$$

yields an expression for GOI_t^+:

$$GOI_t^+ = (1 - \lambda)GOI_{t-1} + [\lambda w_0 + \lambda w_1 r_t + \lambda w_2 \sigma_t^2]TA_{t-1} \tag{A.4}$$

The first component of (A.1) can be approximated linearly by[18]

$$g(\cdot) = r_t[\phi \cdot (TA_t - TA_{t-1})] \; 0 \leq \phi \leq 1 \tag{A.5}$$

where ϕ controls for the period's average change in assets. (If assets change linearly at a constant rate throughout the period, for example, $\phi = \frac{1}{2}$.) Substituting (A.4) and (A.5) into (A.1) yields the following expression for nominal bank operating income (after dividing through by TA_{t-1}):

$$\frac{GOI_t}{TA_{t-1}} = \alpha_0 + \alpha_1 \left(\frac{GOI}{TA}\right)_{t-1} + \alpha_2 r_t + \alpha_3 \sigma_t^2 + \alpha_4 \left[r_t \left(\frac{TA_t - TA_{t-1}}{TA_{t-1}} \right) \right] + \hat{\epsilon}_t \tag{A.6}$$

This is the regression form estimated in the text.

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[18] This specification assumes that σ_t^2 does not affect earnings on net new investable assets. This empirical approximation is based on evidence that σ_t^2 has no statistically significant effect on bank revenue or costs for the great majority of banks examined.

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