The Impact Of Market Interest Rates On Small Commercial Banks

By

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The exposure of financial intermediary firms to market interest rate risk has become a significant concern of regulators, investors, and managers throughout the financial sector. Market rates had become increasingly volatile during the 1970's, with a quantum change accompanying the Federal Reserve Board's October, 1979 policy revisions. Prior to that event, little empirical (or theoretical) research had addressed the impact of market rate fluctuations on financial institutions, though predictions of significant bankruptcies were not infrequent. (Greenbaum, Ali, and Merris [1976] is one exception.) One recent paper (Flannery [1981]) concludes that large commercial banks (assets over $2 billion) had effectively hedged themselves against interest rate risk during the period 1960 to 1978. Market rate changes became reflected equally quickly in these banks' revenue and costs, leaving net operating income statistically unaffected by market rate conditions. Morrison and Pyle [1978] reach the same conclusion via a simulation type model of a "wholesale" bank. Unlike large banks, savings and the loan associations appear to be exposed to sizeable interest rate risk because of their maturity-mismatched asset/liability portfolios (Nadauld [1977]).

What about small, non-wholesale banks? These institutions should be better off than the savings and loans because they have a substantially broader set of assets and liabilities. Yet many small banks share the predominantly retail nature of savings and loan association operations, some even operating as specialized mortgage lenders. Moreover, small banks may be either better or worse off than their money center counterparts. Small bank deposit and loan customers may be relatively insensitive to market conditions, making it unnecessary for smaller commercial banks to respond promptly to sharp market rate swings. If deposit supplies exhibit low cross elasticities with respect to market rates, the bank may earn monopoly profits that fluctuate directly with the level of market rates. Alternatively, if retail loan customers are more averse to interest rate risk than money center borrowers, smaller banks may acquire proportionately more fixed rate loans than do wholesale banks. In addition to all this, small banks may be susceptible to interest rate risk simply because they lack management skills or cannot afford the resources needed to make timely market rate predictions.

For any of these reasons small banks may differ from large banks in their exposure to interest rate risk, but the magnitude of their risk exposure remains a purely empirical issue. This paper evaluates the historical impact of market rate changes on smaller banks' profitability. Section I summarizes the regression specification used to determine the short and long run effects of market rates on bank revenue, costs, and net income. Time series data on sixty individual banking firms with 1978 assets less than $1 billion are described in Section II, along with the statistical techniques employed for efficient estimation. Empirical estimates of each bank's response to market rate changes are presented in Section III, whose conclusion is rather negative: no evidence exists that banks are dangerously susceptible to interest rate fluctuations. Most sample banks' profit margins show no statistically significant response to market rate changes. The conventional wisdom that banks chronically and seriously "borrow short and lend long" is not supported by the data.

Nonetheless, some banks' profits do fluctuate with market rate changes, and regulators would doubtless like to connect observable bank balance sheet and income variables with interest rate risk exposure. Section IV therefore describes a tentative attempt to explain cross-section differences in average asset and liability maturities implied by time series regression results for the sixty sample banks. The paper concludes with a brief summary.

I. THE MODEL

The motivation for this paper's empirical analysis of bank interest rate risk follows from the simple valuation formula:

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

where V = current market value of the bank;

R_t = gross after tax (cash flow) revenues derived by the firm in period t exclusive of capital gains or losses on existing assets and liabilities in the portfolios;

C_t = total after tax (cash flow) cost incurred in period t: interest paid on liabilities plus operating cost;

i_t = the discount applied by the market in period t.

Both C_t and R_t should include regular amortizations of premia or discounts, but exclude realized or unrealized capital gains or losses on bank assets and liabilities.[1]

The concern over bank interest rate risk centers on a presumption that, while R_t and C_t are both responsive to market interest rates, costs come to reflect current market conditions more promptly than revenue.[2] If so, the numerator in (1) can become negative for substantial periods of time, driving market value to zero. Two distinct aspects of market rates are evaluated in the empirical work reported below: the average rate level over the estimation period, and the week-to-week variability of market rates within each year.[3]

The trick to evaluating (1) empirically involves a method of utilizing bank accounting data (the only kind available) to infer the short run and long run responses of individual bank's R_t and C_t to market rate changes. If the reported return on assets (cost of liabilities) always reflected the estimation period's average market rate of interest, for example, one would infer that the bank's assets (liabilities) matured within the estimation period. More realistically, multi-period fixed rate assets (liabilities) cause revenue (costs) to reflect current market rate conditions only with a lag. As described below, the extent of this lag implies average asset and liability portfolio maturities. This method's primary strength lies in its ability to infer average maturities from the data instead of making ad hoc assumptions about the maturity of different asset and liability categories.

Bank Revenues

In the absence of any inherited multi-period assets, the optimal bank asset portfolio would yield a desired or "target" level of reported accounting income:

(2) $$R^* = f(r, \sigma_r^2, TA)$$

where R^* = desired gross operating income

TA = bank total assets

r = average level of the market interest rate

σ^2_r = variability of the market interest rate.

The role of market rate levels (r) in determining a bank's optimal gross revenues is intuitively clear. Rate variability may also affect the bank's asset choices (and hence revenue), for example by changing the relative demands for fixed versus floating rate loans. (See Flannery [1981] for further discussion.) Obviously, expression (2) summarizes a considerable amount of intermediary and customer optimizing behavior.

Since some assets are carried over from the past, actual bank revenue differs from R* to the extent that past market rate conditions differ from those currently prevailing.[4] Reported revenue adjusts toward R* with a lag that depends on the asset portfolio's average maturity (duration), and a properly specified regression equation must incorporate this partial adjustment. In addition, a growing bank acquires new resources each period that can be invested in assets whose returns reflect current market rates.

The Appendix derives (3) as the proper specification for this two-part adjustment process:

$$(3) \quad \frac{R_t}{TA_{t-1}} = \alpha_0 + \alpha_1 \left(\frac{R}{TA}\right)_{t-1} + \alpha_2 r_t + \alpha_3 \sigma_t^2 + \alpha_4 \left[r_t \left(\frac{TA_t - TA_{t-1}}{TA_{t-1}}\right)\right] + \tilde{\varepsilon}_t .$$

The first four terms in (3) describe a standard partial adjustment specification for revenue to R^*; the term multiplying α_4 captures the return on net new assets. Expected coefficient signs are:[5]

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

$$0 \leq \alpha_1 \leq 1$$

$$\alpha_3 \gtrless 0.$$

The revenue stream'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 implied lag constitutes one check on the specification (3).

Bank Operating Costs and Net Income

The optimal cost of acquiring a liability portfolio (C^*) is determined in a way exactly analogous to R^* in (2). Specifying the same type of partial adjustment process, bank costs are described by:

$$(4) \quad \frac{C_t}{TA_{t-1}} = \beta_0 + \beta_1\left(\frac{C}{TA}\right)_{t-1} + \beta_2 r_t + \beta_3 \sigma_t^2 + \beta_4\left[r_t\left(\frac{TA_t - TA_{t-1}}{TA_{t-1}}\right)\right] + \tilde{\mu}_t.$$

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

Finally, the same partial adjustment process was specified for bank net income (NI):

$$(5) \quad \frac{NI_t}{NI_{t-1}} = \gamma_0 + \gamma_1\left(\frac{NI}{TA}\right)_{t-1} + \gamma_2 r_t + \gamma_3 \sigma_t^2 + \gamma_4\left[r_t\left(\frac{TA_t - TA_{t-1}}{TA_{t-1}}\right)\right] + \tilde{\gamma}_t,$$

where net income is the difference between R_t and C_t, less taxes, realized capital gains or losses, and other extraordinary items.

II. ESTIMATION PROCEDURES

Data

In constructing a detailed data base on small (and, in most cases, nontraded) banks, one is effectively limited to the Federal regulatory agencies' Reports of Income and Condition. These are available on computer tapes at least back to 1960, although frequent reporting format changes make it difficult to assemble consistent series for any length of time. Annual data were gathered on individual banks in continuous existence from 1960 to 1978.[6] Twelve insured banks were chosen at random from the national population in each of five asset size categories (base on yearend 1978 assets): less than $25 million, $25-49.9 million, $50-99.9 million, $100-299.9 million, and greater than $300 million. Holding company subsidiary banks were excluded from the first four size groups;[7] banks above $300 million were included regardless of their subsidiary status, since large independent banks may not be representative of the population.[8]

Federal reporting forms underwent a major revision in 1969, making it difficult to compare pre-1969 with post-1968 data. (See Federal Reserve Bulletin (July 1970), especially pages 571-572.) Several reporting categories were changed at that time (e.g. the Provision for Loan Losses is excluded from net current operating expenses prior to 1969 but included thereafter), but consistent time series could be assembled with some care. Two more substantial reporting changes should be noted in detail. First, banks with assets above $25 million were required to accrue all expense and revenue items beginning in 1969. (Either cash or accrual accounting had previously been acceptable.) The effects of changing over from cash to accrual accounting precedures cannot be determined, but they are likely to be small for annual data. In any event, this change affects only the sample's smallest banks.

The second major change in 1969 is potentially more important. Banks may generally form subsidiaries that undertake banking activities at a geographic place in which the bank itself is empowered to operate. The most common subsidiaries involve mortage banking and equipment leasing.[9] Such subsidiaries should reasonably be consolidated with the bank in assessing the effects of market rate changes. Before 1969, banks had the option of consolidating their majority-owned subsidiaries or not. In the latter case, net income from subsidiaries was reported as "income from other investments". After 1968, banks were required to file fully consolidated balance sheet and income statements for significant subsidiaries. To avoid the time series shifts that might occur between 1968 and 1969 for banks that had not been consolidating, banks that consolidated any subsidiaries in 1976, 1977, or 1978 were assumed to have had major subsidiaries before 1969 and were therefore excluded from the sample. (Call Report forms contained no information on the presence of consolidated subsidiaries prior to 1976.) While this procedure does not, of course, guarantee that no sample banks operated important subsidiaries earlier in the sample period, it seems a reasonable enough precaution.

The level of market interest rate was represented by the average annual yield on 3-5 year government bonds. (Empirical results using the 12 month treasury bill rate are very similar.) Market rate variability was proxied by the standard error of an AR1 regression for the weekly bond rates within each year.[10] Conceptual difficulties make it cumbersome or impossible to differentiate anticipated market rate changes from unanticipated. Essentially, the conundrum is that at any point in time a bank's portfolio of fixed rate assets and liabilities has been negotiated over numerous past time periods. Since security values are not marked to market daily, new information is not immediately incorporated into asset or liability prices (book values). The information set relevant to separating anticipated from unanticipated rate changes is therefore ill-defined even in principle. In addition, deposit market imperfections, interest rate ceilings, and so forth may limit the bank's or customers' ability to respond even to rate changes that are fully anticipated by all concerned. Under the circumstances, ex post market rate observations seem at least as relevant as (ambiguously defined) ex ante anticipations would have been.

Bank revenue in (3) is represented by gross operating income, which includes both fee and interest income. Presumably, fee income does not vary particularly with market rates and is largely captured by the constant term in (3). Bank costs in (4) should include all expenses associated with financing the bank's liability portfolio: interest costs and selected noninterest expenses that constitute implicit interest payments on deposit balances subject to Regulation Q. Unfortunately, reported noninterest expenses include both implicit interest items and other operating costs. If the latter--fixed costs and those associated with asset management--do not vary importantly with market interest rates, total operating expenses can be used to represent C_t in regression (4). This seems a plausible assumption.

Net income in (5) is the bank's "bottom line" profit after taxes, realized securities gains or losses and other extraordinary income items. The last two items are somewhat discretionary and can be used to smooth out income fluctuations. (Data on current operating income net of relevant taxes would therefore have been preferable, but were unavailable.) The impact of income smoothing behavior on the empirical results reported below cannot be ascertained. Note, however, that smoothing only re-distributes income through time, and does not create additional, fictitious income. If a bank possesses sufficient net income to smooth out short run interest fluctuations of the relevant size, the danger to bank stability (that is, its exposure to interest risk) cannot be too great! In any event, the basic assessment of a bank's risk exposure can be derived by comparing the revenue and cost regressions ((3) and (4)) without reference to the net income results.

Statistical Techniques

The parsimonious specifications (3), (4), and (5) may well omit some explanatory variables that affect two or more regression equations. These regressions were therefore estimated simultaneously for each commercial bank using Zellner's "seemingly unrelated" method. This approach generates noticeably more efficient (i.e. smaller variance) estimates of the underlying parameters than OLS. In addition, Zellner generates covariances between coefficient estimates in different equations, allowing more accurate comparisons of the revenue and cost stream adjustments to market rate changes.

Autocorrelated disturbances in the presence of a lagged dependent variable in (3) through (5) would bias coefficient estimates (especially the speed of adjustment) and the estimated standard errors. In order to avoid this possibility, each regression was estimated using the iterative Cochrane-Orcutt correction for serial correlation.

Finally, the regression describing gross pre-tax revenue (3) must be adjusted to recognize the tax-free status of interest income from state and local bonds. In equilibrium, the state and local bond rate would be approximately $(1-\tau)$ times the fully taxable rate, where τ is the market's marginal tax rate. Assuming a 50% marginal bank tax rate, reported revenue as a proportion of assets could be adjusted to a pre-tax equivalent by either doubling the interest earned on municipal bonds or by halving the stock of municipal debt held (denoted SL in (3′)). Since data on tax free interest income were unavailable prior to 1969, the latter method was employed, yielding a revenue equation to be estimated:

$$(3') \quad \frac{R_t}{(TA-(0.5)SL)_{t-1}} = \alpha_0 + \alpha_1 \frac{R}{(TA-(0.5)SL)_{t-1}} + \alpha_2 r_t + \alpha_3 \sigma_t^2 + \alpha_4 [r_t (\frac{(TA-(0.5)SL)_t - (TA-(0.5)SL)_{t-1}}{(TA-(0.5)SL)_{t-1}})] + \tilde{\varepsilon}_t .$$

III. EMPIRICAL RESULTS

The paper's primary empirical results are presented in Table 1, which summarizes coefficient estimates and relevant hypothesis tests for each of the sixty sample banks. (Table A-1 in the Appendix reports additional

TABLE 1: Basic Regression Results

Bank Number	α_1	β_1	γ_1	Hypothesis Tests**	$\frac{\alpha_2}{1-\alpha_1}$	$\frac{\beta_2}{1-\beta_1}$	$\frac{\gamma_2}{1-\gamma_1}$
1	1.015	-0.081	0.366	b c	-4.895	-0.045	0.081
2	-0.187	0.575	-0.933*		0.031	0.043	0.017
3	0.483	0.684	0.320	d	-0.040	0.053	-0.05
4	0.906	0.960	1.114		1.312	3.742	0.568
5	0.891	1.025	0.606		1.587	-0.103	0.256
6	-0.338*	1.098*	0.601	b	-0.036	-0.107	0.165
7	0.884	0.519	0.192		-1.346	-0.594	-0.092
8	0.155	0.297	1.029		-0.052	-0.005	-1.642
9	0.211	-0.073	0.687		0.009	-0.024	0.047
10	0.243	-0.112	0.898		0.033	-0.045	-0.058
11	0.883	0.934	0.601		1.003	0.416	0.183
12	0.357	0.591	-0.095	c	0.454	0.438	0.081
13	-0.612*	-0.165	0.378		-0.017	-0.029	0.066
14	0.469	0.661	-0.122	b c d	0.847	0.826	0.022
15	1.085	0.711	0.611	b c d	-2.385	0.069	0.195
16	-0.047	0.120	0.128	a c d	0.259	-0.102	0.077
17	-0.193	-0.178	0.141		-0.114	-0.115	0.019
18	0.707	0.579	-0.465*	b	0.513	0.601	0.014
19	0.260	0.664	0.226	b c	0.777	0.499	0.187
20	0.899	0.921	-0.351		2.639	0.674	0.522
21	0.668	0.774	0.765		1.134	1.393	-0.097
22	0.865	0.921	0.721	c	1.697	0.956	0.193
23	0.552	0.557	0.717		0.885	0.692	-0.018
24	0.660	0.763	0.176		1.111	1.174	0.028
25	0.707	1.026	0.077	b c	1.357	-2.285	0.114
26	0.812	0.803	-0.416		1.489	1.256	0.064
27	1.043	0.793	0.009	b c	-2.529	1.452	-0.066
28	0.815	0.863	0.051		1.705	2.032	-0.020
29	0.535	0.685	-0.023	b c	0.939	0.833	0.061
30	0.600	0.649	0.065		1.747	1.532	0.112
31	0.939	0.902	0.225	d	3.777	1.498	0.189
32	0.834	0.769	0.325		0.933	0.630	0.044
33	0.731	0.823	0.776	a c	1.331	0.912	0.262
34	0.902	1.062	0.389		2.349	-0.749	0.115
35	0.485	1.261*	-0.604	b	-0.023	0.026	0.082
36	0.708	0.770	0.136	b c d	0.672	0.252	0.080
37	0.592	0.755	0.527	b d	1.556	1.471	-0.020
38	0.787	0.890	0.297		0.911	1.503	0.099
39	0.470	0.229	0.785		0.141	-0.001	0.154
40	0.688	0.791	0.344		0.886	0.550	-0.009
41	-0.037	-0.250	0.911		-0.280	-0.178	0.018

TABLE 1: Basic Regression Results (Cont'd)

Bank Number	α_1	β_1	γ_1	Hypothesis Tests**	$\frac{\alpha_2}{1-\alpha_1}$	$\frac{\beta_2}{1-\beta_1}$	$\frac{\gamma_2}{1-\gamma_1}$
42	0.585	0.750	0.631	b	0.189	-0.297	0.067
43	0.851	1.015	0.636	b c	1.806	-2.825	0.167
44	0.846	1.009	0.601	b c	1.577	-8.890	0.069
45	-0.046	0.110	0.308	a c	0.233	-0.164	0.397
46	0.564	0.905	-0.606*	b	1.261	6.313	-0.141
47	0.454	0.458	0.698	a c	0.717	0.259	0.203
48	0.697	0.813	-0.220		1.146	0.974	0.091
49	0.596	0.894	0.802	b c	0.940	1.764	-0.148
50	-0.175	0.110	-0.007		0.732	1.079	-0.044
51	0.341	0.480	0.118	b c	0.654	0.543	0.038
52	0.081	0.010	0.039	a	0.304	0.178	0.093
53	0.725	0.647	0.772	a b	1.914	0.946	0.516
54	0.525	0.616	0.558		1.079	0.961	0.029
55	0.238	0.801	0.263	b c	0.919	1.602	0.179
56	-0.199*	-0.257	0.715	b	0.528	0.377	-0.013
57	0.710	0.846	0.122	c	1.366	1.527	0.120
58	-0.102	0.131	-0.281	b c d	0.604	0.598	0.017
59	-0.037	0.096	0.152		0.831	0.840	0.149
60	0.789	0.626	-0.104	a	1.536	0.372	0.236

*Significantly outside the [0, 1] interval, 5% confidence level.

‡Significantly different from zero, 5% confidence level (one-tailed test).

**Letters indicate acceptance (5% confidence level) of the following hypotheses.

a. Long run interest rate impact on bank revenue $[\alpha_2/(1-\alpha_1)]$ differs from the long run impact on bank cost $[\beta_2/(1-\beta_1)]$.

b. Revenue adjustment speed $(1-\alpha_1)$ differs from cost adjustment speed $(1-\beta_1)$.

c. Revenue interest rate coefficient (α_2) differs from cost cofficient (β_2).

d. Revenue interest rate variability coefficient (α_3) differs from cost coefficient (β_3).

information about these regression.) Banks in Table 1 are numbered in order of increasing asset size. Although it is difficult to summarize 180 regressions, on the whole the estimated models fit the data well. First, F-statistics (reported in Table A-1) indicate statistically significant relations (5% level) for 159 of 180 estimated equations. Second, theory requires that the adjustment speed in each regression lie between zero and unity. This hypothesis is accepted at the 5% level for all but 3 of 60 α_1 estimates, 2 of 60 β_1 estimates and 3 of 60 γ_1 estimates. The number of outliers is well within the margin of experimental error: with three regressions for each of 60 banks, approximately 9 coefficient estimates would be expected to lie significantly outside of the theorectically correct range by chance alone. The majority of "incorrect" adjustment parameters occur in small banks whose accounting procedures may be somewhat unreliable. Finally, the model's overall stability was tested by dividing the sample period in half: 1961-1969 and 1970-1978. Chow tests accepted the hypothesis of homogeneity at the 5% level for 177 of the 180 estimated regressions. (This result has further implications for interpreting the results about bank balance sheet hedging. See the Conclusion.)

Rate Variability. As reported in the Appendix (Table A-1), the market rate variability (σ_r^2) coefficients were only sporadically significant (5% level, one-tailed test): 11 of 60 in the revenue regressions, 10 of 60 in the cost regressions, and 8 of 60 in net income (4 negative, 4 positive). This compares with coefficients on the interest rate level which were significant in 45 of 60 revenue regressions, 31 of 60 cost regressions, and 24 of 60 of net income regressions. More importantly, the study's primary conclusions regarding relative asset/liability maturities and the long run impact of market rate changes on bank profits were basically unaffected by the presence or absence of rate variability among the explanatory variables. The slight impact of market rate variability on bank profits is an important negative conclusion. The ensuing discussion focuses exclusively on market rates levels.

Asset/Liability Average Maturities. The speed with which a bank's revenue adjusts to market rate changes is given by $(1-\alpha_1)$; the liability cost adjustment speed is $(1-\beta_1)$. A maturity mismatch (or "funding gap") corresponds to statistically different estimated values of α_1 and β_1 in Table 1. The estimated coefficients are statistically indistinquishable for 38 of 60 sample banks. Of the remaining 22, the implied asset maturity is significantly shorter for 17. These results contrast sharply with the "borrow short and lend long" view of banking. The hypothesis that banks match maturities is accepted for a sizable majority of sample banks; among those that appear to have different asset and liability maturities 77% lend for a shorter average maturity than they borrow!

Impact of Market Rate Changes. The immediate (contemporary) effect of a change in market rates on a bank's profit margin is measured by the difference between β_2 and α_2. These coefficients are statistically indistinquishable for 39 of 60 banks (65%), still leaving 21 banks showing a significant short run impact of market rates on their pretax profit margin. This effect diminishes over time, as differing asset/liability maturities and different contemporary market rate effects tend to cancel one another out. The long-run impact of a change in market rates on revenue and cost differs (at the 5% level) for only 7 of 60 banks. Most of these institutions (5 of the 7) are large--above $100 million in total assets--and in all seven cases the banks' average interest margin varies directly with the level of market rates. These results are surprisingly sanguine, containing no evidence that market rate fluctuations pose serious dangers to commercial banks as a group. To the contrary, they appear remarkably well hedged against market rate changes. Banks tend to borrow a bit shorter term than they lend, and the only banks with significant long run responses to market rate changes benefit from higher interest rates.

The long run impact of a market rate change on net income constitutes an alternative criterion for evaluating the interest rate risk exposure of banking firms. This measure may be less reliable than the profit margin results reported above because net income is more susceptible to income smoothing manipulations than are revenues or costs. The NI results nonetheless reinforce the impression that market rate risk exposure is not terribly widespread. Thirty-six sample banks show no significant response of NI to market rate changes, and F-statistics indicate that 30% of the NI regressions (18 out of 60) have no explanatory power at all (5% confidence level). (See Table A-1 in the Appendix.) The long run impact on NI of a market rate change differs significantly from zero for only 19 banks, with 17 showing NI positively related to the level of interest rates.[11] As before, the NI regressions indicate that a large majority of banks are not significantly mismatched and those that are seem to benefit from market rate increases.

Short Run Responses to Rate Change. Despite these sanguine long run implications, banks could still be threatened if market rate changes temporarily raise costs substantially above revenue. This possibility turned out to be a red herring. Starting from an assumed long-run equilibrium, each bank's estimated regression coefficients from (3), (4) and (5) were used to simulate the dynamic responses of revenue, costs, pre-tax interest margin, and net income to several patterns of market interest rate shocks:

1. a permanent increase of 100 basis points;
2. a five-year increase of 100 basis points, followed by a return to the initial level;
3. a three year increase of 100 basis points, a one-year drop of 100 basis points, followed by a return to the initial level.

In each case, bank revenues *et al*. converged to their long run levels monotonically. Since the equations are linear in interest rates, larger or smaller transformations of these shock patterns would generate proportional responses in revenue, costs, etc.

Structural Stability. The data evaluated here end in 1978, but institutional changes undertaken since then may prominently affect retail banking (at least on the deposit side) in years to come. If Regulation Q has effectively limited the competition for retail deposit balances, the conclusion that banks are substantially unaffected by market rate fluctuations cannot be extended to a deregulated future. Yet market conditions and institutional arrangements also varied considerably between the 1960's and the 1970's. As market rates moved higher and became more volatile, Regulation Q was liberalized to allow an increasing assortment of longer-term certificate accounts that had not existed prior to 1969. For large money center and regional banks the change was even more dramatic, as negotiable CD ceilings were effectively eliminated in 1970 and the industry moved to a variable prime rate. Despite all this, the Chow tests described above indicate that virtually all the estimated regressions are stable over the entire sample period (1961-1978). Banks responded similarly in both decades to market rate changes, even though the institutional and economic environment underwent significant modifications.

IV. BALANCE SHEET DETERMINANTS OF BANK INTEREST RATE RISK EXPOSURE

Despite the fact that bank interest rate risk exposure does not appear to be widespread, recent history indicates that excessive risk-taking by individual institutions can cause regulatory problems. A method for estimating individual bank's asset/liability balance from reported information would therefore be a useful policy tool for bank regulators. The relatively coarse balance sheet information historically available from public sources will likely make this goal difficult to achieve, though recent Call Report format changes have moved in the direction of providing additional relevant information.

This section contains a tentative effort to explain cross-section variations in asset and liability maturities with readily available balance sheet information. Various asset and liability items were calculated for each bank as a proportion of total assets for the entire sample period and for two subperiods: 1961-1969 and 1970-1978. (Each bank's asset ratios sum to unity, as do the liability ratios.) The following cross-section regression was then estimated separately for assets and liabilitities:[12]

(6) $$C_j = \sum_{t=1}^{n} \delta_i P_{ij} + \omega_j$$

where C_j = the estimated asset (liability) adjustment coefficient of the jth bank: α_1 $(\beta_1)_j$

P_{ij} = proportion of total assets held in the form of the ith asset (or liability) of the jth bank.

By omitting one balance sheet item with known maturity from (6), the δ_i provide estimates of each asset (liability) item's maturity relative to that of the omitted item.[13] Cash was the asset item omitted from the regression; equity was omitted from the liability side. Since neither of these items generates reported revenue or costs, market rate changes are never reflected in the return on cash or cost of equity. A bank with all its assets in cash would have $\alpha_1 = 1$; a bank funded entirely with equity would have $\beta_1 = 1$. Any asset (liability) whose reported return (cost) varies with market rates will increase revenue's (cost's) speed of adjustment when substituted for cash (equity). In other words, all the estimated coefficients in (6) should be negative.

While separate regressions were calculated for three sample periods, the most sucessful results occurred for the period 1970-78. These regressions are reported in Tables 2 and 3. The liability regression is highly significant, and most of the estimated coefficients are either of the correct sign or insignificant. The exception is "Other Borrowings", whose coefficient is large, highly significant and incorrectly signed. This result may be due to the fact that Other Borrowings incorporates a diverse set of liabilities that are not comparable across sample banks.

Maturity differences among the liability categories in Table 2 can be evaluated via the estimated coefficients' variance-covariance matrix. The

TABLE 2: Cross-Section Variation in
Liability Adjustment Speeds (1970-78)

Independent Variable	Dependent Variable, β1
Time and Savings Deposits	0.14 (1.02)
Demand Deposits	-0.62** (3.20)
Other Borrowings	11.9* (2.20)
Mortgage and Capital Notes	-1.43 (0.18)
Federal funds Purchased	-6.71** (3.89)
$\bar{R}^2$	.66
F-statistic	20.29**
Mean of Dependent Variable	.599
SER	.211
n	60

Independent variables are all expressed as a percentage of total assets.

Numbers in parentheses are t-statistics.

* = statistically significant at the 5% level, one-tailed test.

** = statistically significant at the 1% level, one-tailed test.

following liabilities' average maturities differ significantly (5% level) from one another (listed in order of increasing maturity):

Federal Funds Purchased
Demand Deposits
Time and Savings Deposits
Other Borrowings.

It is reassuring to find federal funds with a significantly shorter maturity than the other items. Also notable is the implied demand deposit maturity: significantly longer than federal funds but shorter than time and savings deposits. This finding, if substantiated, would carry important implications for calculating a bank's average liability maturity.

The asset regression in Table 3 also explains a highly significant proportion of the cross-section variation in α_1. The coefficients are all negative or insignificant. The fact that the coefficient on Building and Real Estate exceeds (in absolute value) that on Federal Funds Sold is worrisome, but the difference is statistically insignificant. Most asset categories' implied maturities do not differ statistically from one another, but the maturity of Federal Funds Sold is significantly shorter than Agency and Government Bonds, Gross Loans, and Municipal Bonds. This is, of course, consistent with expectations.

Taken together, Tables 2 and 3 provide grounds for a modest degree of optimism. Even though asset and liability items are quite coarsely defined, the regressions explain a large proportion of the cross-section differences in average maturities. The statistically significant maturity differences appear sensible. With further refinements and more detailed data, this preliminary methodology may ultimately provide some guidance to

TABLE 3: Cross-Section Variation in Asset Adjustment Speeds (1970-78)

Independent Variables	Dependent Variable α_1
Federal Funds Sold	-4.81^{*} (2.28)
Building and Real Estate	-14.6^{*} (2.08)
Agency and Government Bonds	.015 (.03)
Other Securities	-1.33 (.23)
Municipal Bonds	.194 (.11)
Gross Loans	.126 (.44)
$\bar{R}^2$	.53
F-statistic	9.63^{**}
Mean of Dep. Var.	.498
SER	.326
n	60

Independent variables are all expressed as a percentage of total assets.

Numbers in parentheses are t-statistics.

* = statistically significant at the 5% level, one-tailed test.

** = statistically significant at the 1% level, one-tailed test.

regulators concern with identifying maturity mismatched financial institutions. Further research in this direction seems warranted.

CONCLUSION

The primary empirical conclusion emerging from this study can be expressed in a negative fashion: no evidence exists to support the presumption that commercial banks as a group are dangerously exposed to interest rate risk. Individual banks certainly can undertake such risk, but most banks have access to a sufficient range of asset and liability choices to effectively hedge their profit margins. Only seven sample banks display a permanent effect on pre-tax profit margins when market rates change. Even in the short run, profit margins do not swing wildly when market rates change. However, a greater number of sample banks (19 out of 60) exhibit significant market rate effects on their net income. Does this imply that approximately one-third of all banks are potentially endangered by rate fluctuations?

This fraction must be considered a substantial overestimate of interest rate risk exposure for several reasons. First, the sample under consideration does not accurately reflect the bank population. Large banks are greatly overrepresented here, and their net incomes are more likely to show significant interest rate effects. Second, unless income is positively related to market rates, bank market values will vary inversely with interest rates. (To be exact, the change in NI per 100 basis point change in the market rate that just stabilizes bank market value is the bank's capital/asset ratio.) The long run NI results in Table 1 are therefore consistent with banks hedging their market values as opposed to their income streams. Finally, and perhaps most important, the empirical results make no distinction between anticipated and unanticipated rate changes, though the former should have relatively little effect on true (i.e. economic) bank income. At worst, one can fear that one-third of all banks might be exposed to interest rate risk--and this only if the net income results are preferred to the profit margin results reported above.

Preliminary efforts to explain cross section asset/liability balance characteristics from average balance sheet ratios met with limited success. This effort represents an initial step toward regulatory application of the paper's analysis. For individual bank planners, who have or can generate far more detailed information than what is available publicly, this sort of estimation effort may meet with greater success.

Application of these conclusions to the evolving, less regulated financial environment requires an assumption that the underlying model specification will not fundamentally changed. While this situation characterizes all empirical work, many analysts view the post-1978 institutional changes in the depository intermediary sector as profound and far-reaching. Will these results carry forward to an environment without binding Regulation Q ceilings? Clearly, those who believe that implicit interest payments have effectively substituted for explicit will have little patience with the notion of a profound structural shift. For others, the Chow tests reported above should prove relevant: despite the fact that the financial environment of the 1970's differed sharply from the 1960's, very few estimated regressions displayed a statistically significant structural shift between the two decades. Individual banks can (and doubtless will) choose to undertake sizable interest rate risk exposure, but this is by no means a pangeneric element of banking. Regulators can adequately deal with interest rate risk on a case-by-case basis. The uniformity of these conclusions suggests--though it surely does not prove--that the banking _system's_ exposure to interest rate risk should not be a prominent policy concern in the years to come.

FOOTNOTES

[1]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 fixed rate assets. The constancy of nominal returns relative to the discount rate <u>causes</u> the capital loss: substracting that loss from interest income in (1) and discounting once again would double-count the impact of market rates on the asset's value. When capital gain or losses are realized, the situation is further complicated, but this income is very small among sample banks. The absolute value averaged less than .03% of total assets in 1978.

[2]Naturally, market rate changes may affect the discount rate in (1), but for a bank whose market value is initially positive a discount rate change is not very likely to induce firm failure.

[3]See Flannery [1981], for a discussion of why and how these two aspects of market rate conditions should be are separated.

[4]In principle, a bank could adjust its reported revenue to (2) instantaneously by liquidating all old assets whenever market rates change. Such a policy is neither particularly feasible nor advantageous to the bank's shareholders.

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

[6]Banks that acquired other banks via merger during the period were included in the sample provided the acquiring bank did not change its name.

[7]Subsidiary banks were excluded for two reasons. First, an individual bank's cost and revenue data may be biased if the parent has any incentive (tax or otherwise) to transfer cost/revenue among subsidiaries. Since the paper's empirical procedure relies on the accuracy of noninterest costs, it seemed best to exclude holding company subsidiaries. Second, regulators manifest concern about the risk exposure of individual banks, but a holding company may prefer to manage its overall risk exposure by offsetting different subsidiary banks' net positions. If the holding company would tend to "bail out" subsidiaries that become troubled in order to protect its integrity in the financial community, serious interest rate risk exposure among individual holding company subsidiary banks would not neccessarily imply a danger of financial sector instability.

[8]An important further study would investigate whether subsidiary banks are more or less risky in this regard than independent banks. Evidence reported below applies only to sample banks larger than $300 million and suggests no overwhelming difference between the behavior of independent and subsidiary banks. Seven of the twelve largest banks were holding company subsidiaries. Of 3 banks with significant long run profit margin changes following a market rate change, 1 was a subsidary. Of 6 banks showing a significant long run effect on net income, 4 were subsidiaries. (See the discussion of Table 1 below.)

[9]Note that these differ from subsidiaries of the holding company that may own a bank.

[10]Two other measures of market rate variability yielded similar results: the unadjusted standard deviation of weekly rates around the mean, and the range (highest minus the lowest) of rates over the year, omitting the five highest and five lowest observations.

[11]For these 19 banks, the average long run change in net income associated with the market rate increase of 100 basis points is +17.3 basis points (18.9 basis points ignoring signs), compared to a 1978 average value for NI/TA of 103 basis points.

[12]Regressions of the same form explaining cross-section variation in interest rate responsiveness (α_0, β_0, α_2 β_2) were about as successful as those shown in Table 3 and 4.

[13]This interpretation of (6) is valid only if the asset and liability items are homogeneous across sample banks. (For example, all banks' demand deposit balances must possess approximately the same average maturity.) Otherwise, errors in variables may bias the estimated coefficients toward zero.

[14]This specification assumes that σ_t^2 does not affect earnings on net new investable assets.

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APPENDIX

Derivation of Regression Specification (3).

Total nominal revenues can be written

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

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

$$\text{(A-2)} \qquad GOI_t^* = [w_o + w_1 r_t + w_2 \sigma_t^2] TA_{t-1}$$

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

$$\text{(A-3)} \qquad [GOI_t^+ - GOI_{t-1}] = \gamma[GOI_t^* - GOI_{t-1}]$$

yields an expression for GOI_t^+:

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

The first component of (A-1) can be approximated linearly by[14]

$$\text{(A-5)} \qquad g(.) = r_t[\phi . (TA_t - TA_{t-1})] \quad 0<\phi<1,$$

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

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

This is the regression form estimated in the text.

TABLE A-1: Additional Regression Information

Bank #	Corrected R^2			Coefficients on New Assets			Coefficients on σ_r^2		
	TR	TC	NI	α_4	β_4	γ_4	α_3	β_3	γ_3
1	0.973	0.941	0.008*	0.245	0.690	-0.102	0.115	1.064	-1.116
				(2.367)	(7.125)	(-0.954)	(0.103)	(1.217)	(-1.094)
2	0.963	0.968	0.420	0.871	0.508	0.545	0.639	-0.168	0.659
				(4.118)	(3.493)	(1.955)	(0.381)	(-0.138)	(0.452)
3	0.970	0.955	0.404	0.513	0.064	0.305	1.829	-2.398	1.968
				(2.690)	(0.445)	(2.812)	(1.429)	(-1.784)	(2.159)
4	0.910	0.975	0.545	0.482	0.207	0.238	-0.627	-2.324	3.005
				(6.195)	(4.696)	(3.507)	(-0.338)	(-2.021)	(1.539)
5	0.819	0.898	-0.153*	0.503	0.126	0.103	-2.284	3.365	-5.338
				(2.393)	(0.893)	(0.732)	(-0.596)	(1.369)	(2.145)
6	0.970	0.968	0.797	0.305	0.057	0.260	1.968	1.404	-0.420
				(3.472)	(0.472)	(3.735)	(1.767)	(1.242)	(-0.641)
7	0.902	-0.006*	0.369	-0.092	-3.976	2.197	3.620	17.227	-8.321
				(-0.236)	(-2.854)	(1.973)	(1.750)	(2.232)	(-0.902)
8	0.927	0.935	0.626	0.209	-0.013	0.088	3.262	1.247	-1.863
				(1.560)	(-0.126)	(0.816)	(2.082)	(0.916)	(-1.806)
9	0.951	0.904	0.199	0.350	0.127	0.088	2.707	1.723	0.661
				(3.634)	(1.166)	(0.794)	(1.419)	(0.924)	(0.547)
10	0.975	0.913	0.149	0.382	0.025	0.174	-1.010	-2.272	1.423
				(6.605)	(0.786)	(1.296)	(-0.790)	(-1.909)	(0.585)
11	0.924	0.977	0.368	0.670	0.257	0.302	0.328	1.959	-1.050
				(3.358)	(2.370)	(1.862)	(0.139)	(1.781)	(-0.533)
12	0.035*	0.078*	-0.211*	0.086	0.313	-0.170	-4.263	-2.853	-1.287
				(0.161)	(0.865)	(-0.768)	(0.826)	(-0.779)	(-0.533)
13	0.943	0.858	-0.213*	0.882	0.703	0.119	0.712	-0.175	0.540
				(5.454)	(3.020)	(0.310)	(0.514)	(-0.075)	(0.213)
14	0.907	0.882	-0.077*	0.658	0.586	0.033	-3.613	-1.014	-1.172
				(4.493)	(3.268)	(0.468)	(-1.760)	(-0.472)	(-1.736)
15	0.984	0.983	0.427	0.087	0.039	0.071	-3.663	-1.027	-1.266
				(0.838)	(0.442)	(0.864)	(-2.573)	(-1.076)	(-1.186)

TABLE A-1: Additional Regression Information (Continued)

	Corrected R^2			Coefficients on New Assets			Coefficients on σ_r^2		
Bank #	TR	TC	NI	α_4	β_4	γ_4	α_3	β_3	γ_3
16	0.980	0.971	0.489	0.333	0.279	-0.087	-1.089	1.058	2.034
				(3.858)	(2.500)	(-0.731)	(-0.875)	(0.741)	(1.572)
17	0.772	0.838	-0.050*	0.642	0.453	0.274	-1.789	-1.577	-0.492
				(4.367)	(4.162)	(2.321)	(-0.686)	(-0.745)	(-0.295)
18	0.910	0.941	0.018*	0.328	0.072	0.254	2.046	1.177	0.515
				(1.655)	(0.448)	(1.724)	(1.129)	(0.810)	(0.397)
19	0.825	0.959	0.493	0.859	0.380	0.221	-0.977	0.532	-1.093
				(2.579)	(3.388)	(1.532)	(-0.278)	(0.485)	(-0.751)
20	0.947	0.919	-0.086*	0.331	0.696	-0.046	-3.128	0.642	0.798
				(1.096)	(2.339)	(-0.229)	(-1.328)	(0.305)	(0.414)
21	0.971	0.944	-0.085*	0.250	0.137	-0.130	0.626	0.331	2.194
				(1.623)	(0.458)	(-0.576)	(0.421)	(0.108)	(1.311)
22	0.958	0.958	0.585	0.249	0.355	-0.208	-0.324	0.618	1.675
				(1.278)	(2.019)	(-1.592)	(-0.185)	(0.500)	(1.573)
23	0.866	0.894	0.724	0.313	0.337	-0.128	-2.486	-3.358	2.696
				(1.665)	(2.737)	(-1.313)	(-1.081)	(-2.047)	(2.703)
24	0.988	0.942	0.729	1.035	0.597	0.356	-4.425	-4.943	0.226
				(6.145)	(2.154)	(5.105)	(-2.972)	(-2.426)	(0.244)
25	0.918	0.930	0.405	-0.063	-0.026	-0.010	-0.585	2.935	0.662
				(-0.659)	(-0.331)	(-0.216)	(-0.229)	(1.218)	(0.576)
26	0.961	0.951	-0.269*	0.551	0.489	0.149	-2.032	-0.888	-1.387
				(2.356)	(2.077)	(0.842)	(-1.328)	(-.570)	(-1.003)
27	0.984	0.967	0.257	0.619	0.782	0.059	-0.340	-0.589	-0.195
				(4.978)	(4.228)	(0.562)	(-0.248)	(-0.389)	(-0.191)
28	0.976	0.961	-0.163*	0.780	0.771	-0.139	-3.392	-3.304	1.864
				(4.034)	(2.168)	(-0.804)	(-2.127)	(-1.569)	(2.005)
29	0.952	0.948	0.059*	0.098	-0.001	-0.103	-1.500	0.342	-0.341
				(0.419)	(-0.005)	(-0.770)	(-0.979)	(0.235)	(-0.506)
30	0.957	0.958	0.515	0.034	-0.206	0.140	-6.319	-6.356	0.190
				(0.260)	(-1.398)	(1.336)	(-2.762)	(-2.941)	(0.152)

TABLE A-1: Additional Regression Information (Continued)

	Corrected R^2			Coefficients on New Assets			Coefficients on σ_r^2		
Bank #	TR	TC	NI	α_4	β_4	γ_4	α_3	β_3	γ_3
31	0.955	0.968	0.416	0.458	0.248	0.224	-5.246	-1.422	-3.832
				(2.314)	(2.219)	(1.433)	(-2.538)	(-1.522)	(-2.402)
32	0.951	0.944	0.192	0.272	0.298	0.088	-1.275	-0.929	0.054
				(2.066)	(2.929)	(1.634)	(-0.857)	(-0.724)	(0.085)
33	0.939	0.947	0.887	0.281	0.129	0.186	-2.597	-0.481	-0.367
				(0.913)	(0.556)	(1.143)	(-1.444)	(-0.465)	(-0.528)
34	0.982	0.979	0.728	0.362	0.214	0.258	-2.086	-1.486	-0.057
				(1.684)	(1.270)	(2.547)	(-1.317)	(-0.977)	(-0.060)
35	0.963	0.961	0.035*	0.159	0.030	-0.136	2.468	0.100	0.435
				(0.731)	(0.265)	(-1.287)	(1.536)	(0.082)	(0.377)
36	0.876	0.825	0.224	0.808	0.559	0.172	-0.185	1.891	-1.351
				(5.414)	(4.184)	(1.864)	(-0.098)	(0.987)	(-1.295)
37	0.913	0.928	-0.216*	1.032	0.833	-0.006	-5.695	-1.441	-0.185
				(5.150)	(5.578)	(-0.068)	(-1.666)	(-0.497)	(-0.091)
38	0.947	0.900	0.557	0.691	0.508	0.144	0.312	-2.054	1.835
				(4.334)	(3.212)	(0.829)	(0.193)	(-1.117)	(1.353)
39	0.988	0.964	0.773	0.847	0.628	0.186	0.241	0.624	0.435
				(12.142)	(6.717)	(1.850)	(0.222)	(0.474)	(0.301)
40	0.899	0.922	-0.086*	0.597	0.499	0.102	-3.023	-0.192	0.793
				(1.568)	(1.885)	(0.741)	(-1.592)	(-0.114)	(0.705)
41	0.947	0.937	0.464	0.435	0.491	-0.069	5.441	0.918	2.322
				(0.124)	(0.098)	(0.119)	(3.083)	(2.300)	(1.879)
42	0.950	0.894	0.600	0.284	0.249	0.030	5.144	4.448	0.785
				(2.818)	(3.166)	(0.778)	(2.596)	(3.496)	(1.115)
43	0.992	0.980	0.610	0.323	0.420	-0.045	-0.756	-0.004	-0.219
				(3.014)	(3.383)	(-0.626)	(-0.775)	(-0.003)	(-0.396)
44	0.990	0.966	0.689	0.204	0.205	0.002	-1.399	-0.615	0.747
				(3.658)	(2.617)	(0.036)	(-1.653)	(-0.555)	(0.682)
45	0.942	0.879	0.679	0.161	0.241	-0.112	1.335	3.325	-1.617
				(1.631)	(2.774)	(-1.154)	(0.706)	(1.808)	(-1.210)

TABLE A-1: Additional Regression Information (Continued)

	Corrected R^2			Coefficients on New Assets			Coefficients on σ_r^2		
Bank #	TR	TC	NI	α_4	β_4	γ_4	α_3	β_3	$\gamma 3$
46	0.945	0.947	0.283	0.506 (7.943)	0.204 (3.250)	0.148 (3.257)	-1.045 (-0.535)	-3.196 (-1.700)	0.993 (0.603)
47	0.917	0.827	0.878	0.925 (6.148)	0.868 (5.349)	0.162 (3.307)	-0.938 (-0.408)	-0.184 (-0.081)	-0.629 (-0.938)
48	0.946	0.890	0.630	0.907 (5.306)	0.134 (0.891)	0.409 (3.270)	-4.919 (-2.109)	-2.244 (-1.190)	-0.431 (-0.318)
49	0.938	0.919	0.123*	0.186 (0.698)	0.091 (0.386)	0.245 (0.892)	-1.059 (-0.536)	-0.652 (-0.302)	-0.652 (-0.223)
50	0.727	0.642	0.377	0.237 (3.150)	0.077 (0.651)	0.109 (3.317)	-7.967 (-1.652)	-11.369 (-1.819)	1.082 (0.502)
51	0.969	0.936	0.288	0.399 (3.899)	0.026 (0.183)	0.081 (1.095)	-1.593 (-1.490)	0.210 (0.149)	-0.619 (-0.920)
52	0.895	0.696	0.365	0.724 (5.081)	0.456 (3.035)	-0.065 (-0.989)	-0.326 (-0.158)	0.230 (0.084)	-0.196 (-0.144)
53	0.973	0.951	0.928	0.322 (1.550)	0.326 (1.276)	0.014 (0.100)	-3.975 (-2.078)	-2.346 (-1.286)	-1.409 (-1.782)
54	0.951	0.929	0.469	1.014 (9.443)	0.754 (7.262)	0.111 (2.704)	-3.909 (-1.855)	-2.323 (-1.019)	0.263 (0.248)
55	0.884	0.871	0.519	1.190 (3.174)	0.314 (1.018)	0.354 (1.540)	2.788 (0.865)	-2.107 (-0.581)	0.615 (0.306)
56	0.967	0.962	0.035*	0.387 (3.983)	0.206 (1.532)	0.069 (1.200)	0.595 (0.364)	1.571 (0.748)	0.087 (0.152)
57	0.934	0.935	0.903	0.341 (3.410)	0.249 (2.833)	0.060 (2.838)	-0.970 (0.490)	-2.310 (-1.153)	-0.329 (-0.970)
58	0.925	0.849	0.084*	0.458 (4.023)	0.594 (4.656)	-0.020 (-0.202)	1.171 (0.613)	-1.810 (-0.821)	2.786 (1.873)
59	0.927	0.830	0.722	0.324 (8.555)	0.068 (0.980)	0.018 (1.053)	-1.472 (-0.790)	-0.985 (-0.300)	-1.710 (-3.377)
60	0.941	0.406	0.711	0.514 (2.025)	0.095 (0.244)	0.943 (4.032)	-3.531 (-1.568)	-2.697 (-0.948)	-0.164 (-0.070)

Numbers in parentheses are t-statistics.

*Statistically insignificant regression $(F_{5,11} < 1.57;\ R^2 < .406)$.