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8 The Continued Interest-Rate Vulnerability of Thrifts

Patric H. Hendershott and James D. Shilling

U.S. taxpayers are currently making good on a $100 billion or more Federal Savings and Loan Insurance Corporation (FSLIC) loss.[1] At the same time, mounting Federal Deposit Insurance Corporation (FDIC) losses are leading commentators to speculate about the financial condition of that fund. One would hope that the solutions to the depository fund crises would "guarantee" against repetitions of the crises.

The FSLIC debacle is generally viewed as having occurred in two stages.[2] First, sharply rising interest rates easily eliminated the net worth of most thrifts owing to their asset-liability mismatch (borrowing short and lending long). Second, thrifts took substantial risks (doubled their bets) in the 1980s, as one might expect. The latter was made easier by the increase in deposit insurance coverage from $40,000 to $100,000 per account and the enactment of new asset powers (including additional flexibility in writing mortgage contracts). Regulatory forbearance and loose oversight permitted this risk-taking and led, in conjunction with the generous tax provisions of the 1981 Tax Law, to substantial overbuilding in much of the United States and to subsequent real estate depressions in many areas of the country.

Complicating matters has been the erosion in the basic profitability of thrift mortgage portfolio lending. Owing to higher costs of deposit money and increased deposit premiums, thrifts have not been the low-cost supplier of home mortgage credit for some time.[3] With a low basic-profit stream, untoward

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events (credit problems, rising interest rates) quickly reduce capital, rather than just lowering dividends, and, with little capital, soon increase taxpayer liabilities.

We are now supposedly solving the thrift problem by recapitalizing (forbearance is out), reregulating (new assets powers are out), and reintroducing strict oversight. It is noteworthy, however, that the original source of the problem—the vulnerability of thrifts to periods of sustained increases in interest rates—has not been removed. In fact, lessening this vulnerability has been hampered by the new regulations on trading assets—if thrifts sell any existing fixed-rate mortgages (FRMs), they fear they will have to mark all such investments to market. In early 1989, thrifts were still using roughly 40 percent of their short-term deposits to fund long-term fixed-rate mortgage investments, and many of their adjustable-rate mortgages (ARMs) had rate caps that bind in a period of sustained interest rate increases. Because current thrift regulation concentrates on book, not market, values of assets, thrifts could continue to operate even if their net worth were eliminated by increases in interest rates.

In this paper, we attempt to document just how susceptible the thrift industry continues to be to interest-rate risk. Optimistically assuming a 15 percent pretax return on equity in a recapitalized industry, we find that a repetition of the 1977–86 interest-rate cycle would generate cumulative cash-flow losses of $100 billion to $130 billion within seven years. However, with a profitable, well-capitalized industry, profits and capital could absorb this loss with negligible implications for taxpayers. In contrast, if this cycle should occur today or at any time before significant recapitalization and reprofitization occur, taxpayers would be out another $50 billion to $100 billion.

The first two sections of this paper attempt to establish the appropriate starting point for our analysis of thrift interest-rate sensitivity. Section 8.1 constructs an aggregate thrift balance sheet from individual institution data, where the assets and liabilities are aggregated according to period until they reprice. Nonperforming loans and assets that are now disfavored by regulators are assumed to be sold, and two alternative capital infusions are presumed to be made: $60 billion, to provide all thrifts with capital equal to at least 1.5 percent of tangible assets, or $79 billion, to give all thrifts at least 8 percent of risk-weighted assets. Section 8.2 discusses the structure of thrift mortgage portfolios, indicating the distribution of fixed-rate mortgages by coupon rate and of adjustable-rate mortgages by repricing period, rate caps, and teasers. Section 8.3 describes a method for computing changes in thrift net interest income in response to changes in interest rates and calculates the impact of higher interest rates on thrift net income under a variety of assumptions regarding interest rates, mortgage repayments, and thrift reinvestment. The impact on thrift capital and U.S. taxpayers is discussed. A closing section summarizes our findings, and an appendix describes some of the underlying data.

8.1 Observed and Adjusted Thrift Balance Sheets in Early 1989

Table 8.1 contains the total thrift balance sheet for March 1989, obtained by aggregating across all institutions then insured by FSLIC. The lower-case letters in the table refer to rows in table 8A.1 in the appendix. (The method of computing risk-weighted assets, upon which risk-based capital requirements are calculated, is described in table 8A.1, while the current methods for computing tangible and core capital are reported in table 8A.2.) Balance sheets are also presented separately in table 8.1 for those thrifts with negative and positive generally accepted accounting principles (GAAP) net worth.[4] According to these data, 90 percent of thrift assets are in thrifts with positive GAAP net worth.

Of course, these book net worth numbers have little meaning because many assets have market values far below book. Probably the most egregious example is the $133 billion in other assets. As can be seen in table 8.2, this includes $34 billion in real estate owned (foreclosed on REO) and real estate held for development (REH). Other assets also include $20 billion in goodwill and about $60 billion in other items of dubious value. Based upon data reported in Bovenzi and Murton (1988), we estimate that these assets in the

Table 8.1 **Net Balance Sheet, Book Value (billions of $)**

	All Thrifts	Thrifts with Negative Net Worth	Thrifts with Positive Net Worth
Net assets:			
Net fixed rate = (a + b + c + d) − (r + s)	403	43	360
Single-family ARMs = e	327	19	308
Adjustable-rate and balloon = f + g	230	23	207
Net intermediate assets = (h + i) − .75q	31	−5	36
Equities except FHLB-FHLMC = m	4	0	4
Other assets = n	129	25	104
Total assets	1,124	105	1,019
Total risk-weighted assets	824	98	726
Net liabilities and net worth:			
Net short-term = (o + p + .25q) − (j + k + l)	1,082	123	959
GAAP net worth = t	42	−18	60
Total liabilities and net worth	1,124	105	1,019
Memo			
RAP capital	36	−20	56
Required risk-based capital (1992)	66	8	58

Source: Appendix table 8A.1.

Table 8.2 Composition of Other Assets (billions of $)

	1989 Values	% Markdown[a]	Risk-Weighting
REO and REH, net of valuation allowances (ATREO + AREH − A355)	34	61	200%
Equity in service corporations (A490)	25	20	100[b]
Goodwill (A544)	20	100	100[c]
Purchased servicing (A542)	2	20	100
Other assets, net of val allow (ATOA[d] − A590)	30	20	100
Fixed assets, net of val allow	18	NA	100
Equities except FHLB-FHLMC	4	0	100
Subtotal	133		

Source: Office of Thrift Supervision, quarterly *Thrift Financial Report* (March 1989).
[a]Data on percentage markdowns were obtained from Bovenzi and Murton (1988).
[b]Equity in service corporations that are engaged in impermissible activities is in 100 percent bucket; that in those engaged in permissible activities is in 50 percent bucket (permissible activities have not yet been defined).
[c]Amount counted as assets is the minimum of total goodwill (A544) or 1.5 percent of tangible assets (A800 − A525 − A544 − C992).
[d]ATOA = other assets (A460 through A580 − A490 − A544 − 542) + financing leases (A240 through A260) − deferrals (A525 + C992).

aggregate, excluding fixed assets (branches, etc.), are overstated by $32 billion dollars.[5] In addition, $35 billion of loans are nonperforming (16 percent of loans at thrifts with negative net worth are delinquent). If we value these loans at 80 cents on the dollar, market value is $7 billion below book (we show in section 8.2 that the market value of performing fixed-rate mortgages approximates their book value). Finally, the $15 billion of thrift junk bonds (part of the intermediate assets category in table 8.1) are probably $4 billion below market value. Taking into account all these deviations of market from book values, the market value of net worth for the industry is negative $23 billion, not positive $20 billion. Also, only 50 percent of thrift assets are held by thrifts with positive market-value net worth.

Table 8.3 is an adjusted aggregate balance sheet based on the following assumptions. First, all the other assets in table 8.2, except for fixed assets, are "sold" for $94 billion, and equities (except FHLB-FHLMC stock) are sold for par. Second, $35 billion of loans ($4 billion each of FRMs and ARMs and $27 billion of other adjustable-rate and balloon loans) are sold for $28 billion, and $15 billion in junk bonds are sold for $11 billion. Third, all of the sale proceeds are used to reduce short-term debt. The result is a 15 percent reduction in thrift total assets. Fourth, we infuse the industry with new capital and use this, too, to reduce short-term debt.

We analyze two infusions. In the first, each thrift is given sufficient new

capital to raise its capital to 1.5 percent of total assets (the tangible capital requirement). In the second, each thrift is given enough capital to increase its capital to 8 percent of risk-weighted assets, or roughly 5 percent of total assets. The two infusions are $60 billion and $79 billion. With the smaller infusion, short-term deposits are reduced by 14 percent; with the larger infusion, the reduction is 16 percent. We take the resultant balance sheet(s) shown in table 8.3 as the starting point for our analysis (actually, the individual thrift balance sheets that are consistent with this aggregate balance sheet are the starting point).

Table 8.3 indicates that thrifts still have a substantial asset-liability maturity imbalance poblem. A full 40 percent of thrift assets would be long-term fixed-rate loans funded by short-term deposits. (The $399 billion is slightly greater than the dollar value of fixed-rate loans funded by short-term deposits

Table 8.3 **Adjusted Balance Sheet (billions of $)**

	All Thrifts	Thrifts with Negative Net Worth	Thrifts with Positive Net Worth
Net assets:			
Net fixed rate	399[a]	179	220
Single-family ARMs	324[b]	98	226
Adjustable-rate and balloon	202[c]	78	124
Net intermediate assets	16[d]	3	13
Other assets	22[e]	9	13
Total assets	963	367	596
Total risk-weighted assets	635	257	378
Net liabilities and net worth:			
Net short-term	920[f]	358	562
	(901)	(345)	(556)
Market-value net worth	43[g]	9	34
	(62)	(22)	(40)
Total liabilities and net worth	963	367	596
Memo:			
RAP capital before capital infusion	−20	−51	31
Risk-based capital (1992)	51	21	30

[a]Net fixed rate reduced by the $4 billion of fixed-rate mortgage loans assumed to be delinquent.
[b]Single-family ARMs reduced by the $4 billion of adjustable-rate mortgage loans assumed to be delinquent.
[c]Adjustable-rate and balloon reduced by $27 billion estimated to be delinquent.
[d]Net intermediate assets reduced by $15 billion in junk bonds.
[e]Other assets are reduced by $111 billion, as all other assets except fixed assets are assumed to be sold, but increased by $4 billion of appraised equity capital.
[f]Net short-term liabilities are reduced by $102 billion of proceeds from asset sales and $60 billion ($79 billion) infusion of new capital to bring tangible capital (RAP capital) to 1.5 percent of tangible assets (8 percent of risk-weighted assets).
[g]Net worth is reduced by $63 billion loss on asset sales, but increased by an assumed $60 billion ($79 billion) capital infusion. This infusion is the amount of capital needed to bring core capital (RAP capital) to 1.5 percent of tangible assets (8 percent of risk-weighted assets), $58 billion ($71 billion) for thrifts with negative net worth and $2 billion ($8 billion) for other thrifts.

a decade earlier.) In addition, many of the adjustable-rate loans have rate caps that will bind significantly if we experience a period of rates rising as sharply as they did in the late 1970s and early 1980s. While thrifts could be hedging much of this risk through cash markets or with futures, interest-rate swaps, interest-rate caps, and so on, the data indicate little cash-market hedging, and anecdotal evidence suggests little use of other hedging devices.[6]

Table 8.4 shows some detail on how the industry's assets are distributed across thrifts with different percentages of required and actual capital, both before and after our liquidating the below-market thrift assets and injecting new capital into the industry. For the observed balance sheet, we define capital in three ways: 8 percent of risk-weighted assets (the end of 1992 requirement), RAP capital (regulatory accounting capital, see table 8A.2) and actual (our estimate) market-value capital. Note that the end of 1992 regulations require that almost all thrifts have capital greater than 3 percent of total assets. Currently, two-thirds of thrift assets are in thrifts that have 3 percent RAP capital, but only 29 percent of thrift assets are in thrifts with 3 percent market-value capital. Moreover, 44 percent of thrift assets are (as of March 1989) in thrifts with negative market-value capital.

When the balance sheet is adjusted, the required capital-to-total-asset ratio for most thrifts declines because we have liquidated relatively risky assets. Actual capital, of course, rises. With the smaller infusion, all thrifts have

Table 8.4 **Dollars of Assets in Institutions with Different Percentages of Required (Risk-based) and Actual Capital (billions of $)**

	Observed Balance Sheet			Adjusted Balance Sheet		
Capital/ Total Assets	Risk-based	RAP Capital	Market Value[a]	Risk-based	Market Value, $60 billion Infusion[b]	Market Value, $79 billion Infusion[c]
6%+	57	321	129	15	143	200
5–6%	41	176	60	75	59	136
4–5%	255	265	80	706	108	464
3–4%	908	156	133	383	130	339
2–3%	121	100	156	40	160	80
1–2%	6	62	114	4	623	4
0–1%	0	63	112	0	0	0
Negative	0	245	604	0	0	0
Total	1,388	1,388	1,388[d]	1,223	1,223	1,223[e]

[a]Market value capital = GAAP net worth in table 8.1, after assets are marked to market; includes appraised equity capital.
[b]Infusion brings tangible capital up to at least 1.5 percent of tangible assets.
[c]Infusion brings RAP capital up to at least 8 percent of risk-weighted assets.
[d]Book value of total assets from appendix table 8A.1, including loans on deposits and deferred losses.
[e]Adjusted value of total assets = book value of total assets, including loans on deposits − delinquent mortgage loans − junk bonds − equities except FHLB-FHLMC − other assets except fixed + appraised equity capital.

Table 8.5 **FRM Balances of Different Maturities Subdivided by Coupon Rate (billions of $)**

Coupon	Maturity (in years)			Total	GNMA Price[a]	Market Value[b]
	5 to 10	10 to 20	Over 20			
Less than 8%	5.5	11.2	3.8	20.5	92½	19.0
8–8.99%	5.1	37.4	35.1	77.6	94¾	73.5
9–9.99%	4.4	43.4	60.3	108.1	99½	107.6
10–10.99%	2.6	21.3	39.1	63.0	103½	65.2
11–11.99%	1.1	6.7	8.8	16.6	106¾	17.7
12–13.99%	1.5	3.8	6.3	11.6	110¼	12.8
14% or more	0.3	0.6	0.7	1.6	112	1.8
Total				299.0		297.6

Source: Office of Thrift Supervision, *Thrift Financial Report* (September 1989). We thank Bill McGuire of the Federal Home Loan Bank of Cincinnati for providing us with the FRM balance data.

[a]On 20 February 1990.

[b]Book (total) times GNMA price divided by 100.

capital of at least 1.5 percent of assets, but note that less than half of thrift assets are in thrifts with at least 2 percent market-value capital. With the larger infusion, over 90 percent of thrift assets are in thrifts with over 3 percent market-value capital.

8.2 Thrift Mortgage Portfolios

Both the market values of thrift FRM and ARM portfolios and the sensitivity of these to increases in interest rates depends on the level of the coupons on the mortgages relative to market coupon rates and the tightness of ARM rate caps. This section provides the available data on FRMs and ARMs.

Table 8.5 contains the distribution of FRMs on September 1989 according to coupon and remaining term to maturity. As can be seen, 80 percent had coupons between 8 and 11 percent. The second column from the right gives 20 February 1990 prices on Government National Mortgage Association (GNMA) securities with coupons equal to 8 percent, the midpoint of each of the coupon ranges in column 1 (rows 2–6), and 14.5 percent, respectively. The far right column is an estimate of the market value of the volume in each coupon range. Cumulating over the ranges, one obtains a market-value estimate for the total industry FRM portfolio only $1.3 billion less than book value. That is, in February 1990, below-market FRMs were not an industry problem.

Table 8.6 reports the distribution of ARMs originated at 707 thrifts during May–July of 1986 through 1989, by the years to repricing ($\leq$1 year vs. $>$1 year), the annual rate cap (1 or 2 percent), and the magnitude of the initial teaser ($<$0.5 percent up to $\geq$2.5 percent). The data do not indicate significant

Table 8.6 **Distribution of ARMs by Size of Teaser, Years Until Repricing, and Annual Rate Caps**

	Years to Reprice		Annual Cap		Teaser			
	≤1	>1	1%	2%	<0.5	0.5–1.5	1.5–2.5	≥2.5
1986	93	7	17	83	42	23	29	6
1987	90	10	19	81	39	13	37	11
1988	93	7	23	77	40	6	36	18
1989	93	7	18	82	38	12	26	24

Source: Appendix table 8A.3.

Table 8.7 **Distribution of ARMs by Percentage that Fully Adjusted Rate is Below Maximum Loan Rate (% of ARMs)**

Percentage Below Maximum Rate	1-year (and less) Annual Cap		3-year (and more) Annual Cap		Total
	1%	2%	1%	2%	
<1.1%	0.27	0.12	0.00	0.08	0.48
1.1–2.0%	0.48	5.16	0.00	0.16	5.80
2.1–3.0%	2.34	14.29	0.03	0.40	17.06
3.1–4.0%	2.36	12.00	0.02	0.94	15.31
4.1–5.0%	7.38	21.14	0.29	2.53	31.33
5.1–6.0%	2.01	5.95	0.11	1.71	9.77
>6.0%	2.92	14.48	0.29	2.54	20.24
Total	17.75	73.15	0.74	8.36	100.00

Source: Federal Housing Finance Board, Mortgage Interest Rate Survey, May–July of 1986–89.

changes over time in either the years to repricing or the per-period rate cap. Just over 90 percent of ARMs issued in each year reprice within a year, and roughly 80 percent of ARMs have 2 percent annual caps. Virtually all of the ARMs have 5 percent life-of-loan caps.

In contrast, there is a clear trend toward the use of heavily discounted initial interest rates, or teaser rates, after 1986. The percentage of ARMs with a teaser of 2.5 percent or greater rose from only 6 percent in 1986 to 24 percent in 1989. This could be an indication of increased risk-seeking by underwater thrifts. These deep teasers are a potential problem because the effective life-of-loan rate cap on a deep teaser is lower than that on a shallow teaser, that is, rate caps on deep-teaser loans are more likely to bind.

Tables 8.7 and 8.8 illustrate the potential problems with deep-teaser ARMs. In March 1989, 23 percent of ARMs had coupon rates less than 3 percentage points from their maxima, and another 15 percent were within 4 percentage points. As is shown in table 8.8, most (84 percent) of the ARMs within 3 points of their life-of-loan caps were one-year (or less) ARMs with a 2 percent

Table 8.8 **Percentage of ARMs in Institutions Having More Than *X* Percent of ARMs with Fully Adjusted Rate Within 3 Percent of Life-of-Loan Rate Ceiling**

	1-year (and less) Annual Cap		3-year (and more) Annual Cap		
X%	1%	2%	1%	2%	Total
<10%	0.16	0.53	0.03	0.03	0.75
10–19%	0.66	0.84	0.00	0.11	1.61
20–29%	0.89	1.99	0.00	0.18	3.05
30–39%	0.45	5.19	0.00	0.25	5.89
40–49%	0.10	0.84	0.00	0.02	0.96
50–59%	0.00	0.34	0.00	0.00	0.35
>59%	0.86	9.86	0.00	0.06	10.78
Total	3.11	19.59	0.03	0.65	23.38

Source: Federal Housing Finance Board, Mortgage Interest Rate Survey, May–July of 1986–89.

per period cap, and these were concentrated within a few thrifts. More than half of these ARMs were at institutions with over 60 percent of their ARMs within 3 points of the ceiling, and 60 percent were at a single institution.

In the calculations reported in the next section, we assume that ARMs originated by all thrifts throughout 1986–89 were either one- or three-year Treasury ARMs and had terms (teasers, rate caps, and fully adjusted margins) identical to those at the 707 thrifts from which we have data. ARMs originated in 1982–85 are assumed to have been identical to those originated in 1986. We further assume that all originated ARMs have been maintained in the portfolios of the originating institutions. While these assumptions are obviously not fully correct, there is no reason to believe that they bias our loss calculations either up or down.

8.3 The Impact of Increases in Interest Rates

One can compute the impact of changes in interest rates on the thrift industry in two ways. First, one could postulate a one-time change in interest rates and calculate the change in the market values of thrift assets and liabilities, and thus net worth. Second, one could postulate an altered future path of interest rates, calculate the impact on thrift net interest income, and cumulate the net income changes over time. These calculations are related because the market value of an asset is the sum of the asset's expected future cash flows, appropriately discounted. Because computing market values of a wide variety of assets with call options and rate caps is such a formidable task (see, for example, Schwartz and Torous, in this volume), we have chosen the second method. We will, however, analyze a complete cycle—interest rates rising and falling—and we cumulate net income changes for a decade following the

completion of the cycle, thereby capturing most of the market-value implications of assets put on the books while interest rates were temporarily high. We begin by describing a method for calculating net interest-income losses and then present the calculations.

8.3.1 Method for Calculating Net Interest Income Losses

When interest rates rise, the net income from FRMs funded with short-term deposits declines and may turn negative. The decline in net income equals the increase in deposit interest paid less any increase in interest income coming from the investment of FRM repayments at higher interest rates. Assume that the initial book value of short-funded FRMs is FR and that a constant function, ϕ, of these mortgages repay each year. If deposit rates rise from r_0 to r_1, the interest lost in the next year, assuming 100 percent debt financing, is simply $(r_1 - r_0)(1 - \phi)FR$. This loss is then multiplied by the initial ratio of short-term liabilities to net financial assets, Θ_0, to reflect less than 100 percent debt financing.

The cumulative loss on the initial short-funded FRMs over a twenty-year period, ignoring losses on repayments (or simply assuming they are reinvested at the all-in deposit cost), is

$$FR\sum_{t=1}^{20}(1 - \phi)^t\Theta_0(r_t - r_0).$$

If repayments at the end of year 0, ϕFR, are reinvested in FRMs, they will generate additional future losses if deposit rates continue to rise unexpectedly or will produce future gains if deposit rates return to their initial levels. The cumulative loss over the next twenty years from repayments at the end of year 0 is

$$\phi FR\sum_{t=1}^{20}(1 - \phi)^{t-1}[\Theta_1(r_t - r_0) - (r_1^{\text{FRM}} - r_{0A}^{\text{FRM}})],$$

where $r_{0A}^{\text{FRM}} = \sum_j w_j r_{0-j}^{\text{FRM}}$ and w_j is the proportion of the outstanding FRM stock originated j periods ago. More generally, the total cumulative loss, assuming that all prepayments are reinvested in FRMs, is

$$\begin{aligned} L_{\text{FRM}} = {} & FR\sum_{t=1}^{20}(1 - \phi)^t\Theta_0(r_t - r_0) + \phi FR\sum_{t=1}^{20}(1 - \phi)^{t-1}[\Theta_1(r_t - r_0) \\ & - (r_1^{\text{FRM}} - r_{0A}^{\text{FRM}})] + \ldots \\ & + \phi FR\sum_{t=20}^{20}(1 - \phi)^{t-20}[\Theta_{20}(r_t - r_{19}) - (r_{20}^{\text{FRM}} - r_{19A}^{\text{FRM}})]. \end{aligned} \tag{1}$$

The losses for ARMs are calculated similarly. If the book value of short-funded ARMs is AR and deposit rates rise from r_0 to r_1, the interest lost in the next year is $[\Theta_0(r_t - r_0) - (r_{01}^{\text{ARM}} - r_{0A}^{\text{ARM}})](1 - \phi)AR$. Of course, if the ARM

coupon rises by the increase in deposit costs and 100 percent debt financing is employed ($\Theta = 1$), no interest is lost. The cumulative loss on AR over the twenty-year period, ignoring repayments, is

$$AR\sum_{t=1}^{20}(1 - \phi)^t[\Theta_0(r_t - r_0) - (r_{0t}^{\text{ARM}} - r_{0A}^{\text{ARM}})].$$

If repayments, ϕAR, are reinvested in identical ARMs (except for their higher initial rate), the repayments can also generate losses should rates rise further in the future. This loss over the next twenty years is

$$\phi AR\sum_{t=1}^{20}(1 - \phi)^{t-1}[\Theta_1(r_t - r_1) - (r_{1t}^{\text{ARM}} - r_{1A}^{\text{ARM}})].$$

The total cumulative loss, assuming all prepayments are reinvested in identical ARMs, is

$$\begin{aligned} L_{\text{ARM}} = {} & AR\sum_{t=1}^{20}(1 - \phi)^t[\Theta_0(r_t - r_0) - (r_{0t}^{\text{ARM}} - r_{0A}^{\text{ARM}})] \\ & + \phi AR\sum_{t=1}^{20}(1 - \phi)^{t-1}[\Theta_1(r_t - r_1) - (r_{1t}^{\text{ARM}} - r_{1A}^{\text{ARM}})] + \cdots \\ & + \phi AR\sum_{t=20}^{20}(1 - \phi)^{t-20}[\Theta_{20}(r_t - r_{20}) - (r_{20t}^{\text{ARM}} - r_{20A}^{\text{ARM}})]. \end{aligned} \tag{2}$$

We still need to specify the coupon on existing ARMs. If interest rates have risen since the ARM was originated, the coupon at time t is the minimum of the fully adjusted coupon (r_{jt}^F) and of the coupons resulting from binding annual (c_A) and life-of-loan (c_L) rate caps:[7]

$$r_{jt}^{\text{ARM}} = \min(r_{jt}^F, \hat{r}_{jt}^A, \hat{r}^L{}_{jt}), \tag{3}$$

where $\hat{r}_{jt}^A = r_{jt-1}^{\text{ARM}} + c_A$ and $\hat{r}^L{}_{jt} = r_{j0}^{\text{ARM}} + c_L$. If interest rates have fallen, the coupon is the maximum of the fully adjusted coupon and that resulting from a binding annual rate floor (f_A):

$$r_{jt}^{\text{ARM}} = \max(r_{jt}^F, \hat{\hat{r}}_{jt}), \tag{4}$$

where $\hat{\hat{r}}_{jt} = r_{jt-1}^{\text{ARM}} - f_A$.

The total loss in interest income (for each year from initial year 0), due to a series of upward-interest-rate surprises, is the sum of the losses on FRMs, ARMs, and intermediate assets, minus the gain from less than 100 percent debt financing of fully adjustable rate loans (ADJ). In equation form,

$$\text{Lost Income} = L_{\text{FRM}} + L_{\text{ARM}} + L_{\text{INT}} - \sum_{t=1}^{N}(1 - \Theta_0)(r_t - r_0)\text{ADJ}, \tag{5}$$

where L_{INT} is the negligible loss from short-funding intermediate assets, and the summation measures the gain from fully adjustable rate loans.[8]

The capital loss for a thrift is the difference between lost income and the thrift's earnings in the absence of interest-rate increases. In the absence of rate increases, thrifts would do very well, earning the value of the call options and rate caps on home mortgages they are selling to households plus a normal return on equity. We assume that the value of the call options and rate caps is equivalent to a 0.75 percent annual return on their home mortgage portfolios, or $5 billion a year given an FRM plus ARM base of $732 billion. The value of ARM rate caps obviously varies with the specific terms of the ARM contract—deep teasers and tight caps have greater value to borrowers (see Schwartz and Torous, in this volume)—and with economic conditions—when interest rates are expected to rise and/or rate volatility is high, caps are worth more (Buser, Hendershott, and Sanders 1985). Similarly, the value of the call option is less the lower is the mortgage coupon relative to market coupons and the less likely are interest rates to decline (Buser, Hendershott, and Sanders 1990). We have not attempted to account for these differences; raising or lowering the $5 billion estimate by, say, 25 percent would have little impact on our calculations.

We take the normal pretax return on equity, somewhat optimistically, to be 15 percent. When thrifts have $43 billion in capital (the $60 billion infusion), this implies an average 0.0067 return on total assets (TA) and a $6.5 billion cushion, in the aggregate, against declines in net interest income. We compute the capital loss as [9]

$$(6)\quad \text{Capital Loss}_t = \text{Lost Income}_t - 0.0075(\text{FRM}_t + \text{ARM}_t) - 0.0067\text{TA}_0.$$

8.3.2 Loss Calculations

Given unchanged asset and liability mixes and no asset sales, net interest income losses depend on three factors: the pattern of future deposit and mortgage interest rates, the rate at which mortgages repay, and the extent to which repayments are reinvested. We do not want to analyze the expected or most likely future path of interest rates because expected future rates likely differ little from current rates. Rather, we want to analyze a "bad case" scenario. We take as our bad scenario—one that might plausibly occur over the next decade or two—that which occurred in the decade 1977–86.

Table 8.9 presents data on interest rates and mortgage repayments during the 1977–86 period. Both one- and three-year Treasury bill rates rose by 8 to 9 percentage points between 1977 and 1981, fell by 4 to 5 points between 1981 and 1983, rose by 1.5 points in 1984, and then fell by over 2 points in 1985 and 1986. The observed ratio of annual aggregate thrift mortgage repayments (amortization plus prepayments) to mortgage loans outstanding was 11 percent in 1977–78, when some of the high-rate mortgages originated in 1973–74 were refinanced, fell to around 7 percent in 1980–82 when mortgage rates peaked, jumped to 15 percent in 1983–85 when many of the 1980–82 mortgages were being refinanced, and increased even further when mortgage

Table 8.9 Interest Rates and Mortgage Repayments

Year	Treasury Yields (%)		Mortgage Repayment Rate
	1-year	3-year	
1977	6.09	6.69	11.51
1978	8.34	8.29	10.82
1979	10.67	9.71	9.50
1980	12.05	11.55	7.56
1981	14.78	14.44	6.29
1982	12.27	12.92	7.61
1983	9.37	10.45	15.48
1984	10.89	11.89	14.84
1985	8.42	9.64	14.47
1986	6.30	7.06	17.83

Source: Treasury yields are from *Federal Reserve Bulletin*, U.S. Treasury Notes and Bonds Constant Maturities; mortgage repayment rate is from Office of Thrift Supervision, *Savings and Home Financing Source Book.*

rates troughed in 1986. In our bad-case scenario, we let the one- and three-year Treasury rates move exactly as they did in the 1977–86 period and then hold them at their 1977 values for the next decade. Rates on FRMs are assumed to move by 80 percent of the variation in the one-year rate.

A single repayment factor for FRMs is inappropriate given the obvious sensitivity of repayments to interest rates. In the aggregate, FRMs are presumed to repay at the rates observed over the 1977–86 period during the first ten years of our scenario. However, mortgages originated in different years are assumed to repay at different rates. In years 7–9 (1983–85), mortgages originated in years other than 4–6 (1980–82) are presumed to repay at a 9.5 percent rate, and the mortgages for years 4–6 are presumed to repay at a rate sufficient to raise the overall FRM repayment rate to 15 percent. In years 10 and beyond, FRMs originated before year 4 (1980) and after year 9 (1985) are assumed to repay at the 9.5 percent rate; originations in all other years repay at an 18 percent rate.[10] For ARMs, we assume a 10 percent repayment rate.

We also simulate a less-severe interest rate cycle in which interest rates move by half the 1977–86 movement. This is not unlike the movement in interest rates in the 1965–72 period. For FRMs, we keep the basic 9.5 percent repayment rate, varying it in the same years as before but only by half as much. For ARMs, we use the basic 10 percent repayment rate.

The upper panel of table 8.10 contains the scenario where interest rates move as they did in the 1977–86 period (see col. 1 of the table). The tenth year contains the losses for years 10 to 20, present valued to the tenth year using the tenth year one-year Treasury rate, and the far right column gives the totals. The total loss is divided into portions owing to FRMs and ARMs, and the total is reduced by the earnings thrifts would have recorded had interest

Table 8.10 **Calculated Value of Cash-Flow Losses on Net Adjusted Assets of Insured S&Ls and Potential Capital Losses (billions of $)**

Year	1	2	3	4	5	6	7	8	9	10+	Total
A. Rates Rise as in 1977–86 Period											
Change in 1-year Treasuries	2.25	2.33	1.38	2.73	−2.51	−2.70	1.32	−2.47	−2.12	−0.21	0
Cumulative change in 1-year Treasury	2.25	4.58	5.96	8.69	6.18	3.48	4.80	2.34	0.21	0	0
Loss due to FRMs	8	14	16	21	11	3	5	(1)	(5)	(9)	63
Loss due to ARMs	2	5	7	12	4	(1)	1	(1)	(2)	0	27
Total loss[a]	10	19	22	32	15	2	6	(2)	(7)	(9)	88
Cumulative loss	10	29	51	83	98	100	106	104	97	88	88
Capital loss	1	7	10	21	4	0	0	0	0	0	43
B. Rates Rise Half as Much											
Change in 1-year Treasuries	1.13	1.17	0.69	1.36	−1.25	−1.35	0.66	−1.34	−1.06	−0.11	0
Cumulative change in 1-year Treasury	1.13	2.30	2.99	4.35	3.11	1.76	2.41	1.17	0.11	0	0
Loss due to FRMs	4	7	8	10	6	1	3	(1)	(3)	(4)	31
Loss due to ARMs	1	2	2	3	1	(1)	0	0	0	0	8
Total loss[a]	5	9	10	13	7	0	3	(1)	(3)	(4)	39
Cumulative loss	5	14	24	37	44	44	47	46	43	39	39
Capital loss	0	0	0	2	0	0	0	0	0	0	2

[a]Includes a negligible loss on net intermediate assets and a small gain from less than 100 percent debt financing of fully adjustable rate loans.

rates not risen to give the capital loss. As can be seen in the far right column, the cumulative loss is $88 billion. Moreover, the cumulative losses reach $106 billion in the seventh year. Most of the losses are on FRMs, although ARMs account for $27 billion of the loss. Finally, the cumulative capital loss, that is, the potential cost to the taxpayer is $43 billion.

The lower panel of table 8.10 pertains to a less-severe increase in interest rates; as the first row shows, the rates are up by only half as much as in the top panel. As one would expect, the losses on FRMs are about half as great. For ARMs, though, the losses are only 30 percent as large ($8 billion vs. $27 billion). This is because the 2 percent per annum cap never binds and the life-of-loan cap binds far less than half as much. The cumulative cash-flow loss is still $39 billion, but there is virtually no capital loss.

Table 8.11 gives more detail on the ARM losses and summary statistics for alternative reinvestment scenarios. Looking at column 1 first, we see that most of the ARM losses are due to life-of-loan caps and little result from annual caps. While the annual caps cause some loss in the first two years (after which the life-of-loan cap binds), the annual rate floors save a little interest when interest rates decline. Two reinvestment alternatives are considered. First, we assume that FRM repayments are not reinvested but rather are used to reduce short-term borrowing. Second, we assume that both FRM and ARM repayments are reinvested in ARMs.

In the original calculations, FRM repayments were assumed to be reinvested in FRMs paying the then-higher coupon rate. In the first year or two, when interest rates have not risen sharply, reinvestments increase losses because the higher coupon income over the life of the mortgage will not outweigh the higher deposit costs over the interest rate cycle. However, reinvestments later on, when mortgage rates are near their peak, will generate far more interest income than the temporarily higher deposit costs. On net, rein-

Table 8.11 **Breakdown of Losses Under Alternative Interest Rate Scenarios and Repayment Assumptions (billions of $)**

	Full Rate Rise			Rates Rise Half as Much		
	Base Case	No Reinvestment of FRMs	Reinvestment of FRMs in ARMs	Base Case	No Reinvestment of FRMs	Reinvestment of FRMs in ARMs
Loss due to FRMs	63	111	111	31	53	53
Loss due to ARMs	27	25	32	8	7	13
without annual cap	23	21	27	7	6	11
without life-of-loan cap	11	10	13	6	5	10
Total loss[a]	88	133	141	39	60	65
Capital loss	43	57	66	2	6	9

[a]Includes a negligible loss on net intermediate assets and a small gain from less than 100 percent debt financing of fully adjustable rate loans.

vestment in FRMs reduces losses from the interest rate cycle.[11] Thus, assuming no reinvestment (assuming that the industry is downsized) increases the cumulative losses on FRMs by $48 billion and increases the total loss by $45 billion. However, the aggregate capital loss rises by only $14 billion because most of the additional cash-flow losses come after year 6 and are offset by the basic $11.5 billion cash flow thrifts would earn in the absence of a rise in interest rates.

Given that interest rates eventually decline to their initial values, reinvesting FRM repayments in ARMs makes things even worse because high-coupon ARMs adjust downward when interest rates come back down. Thus the losses from reinvestment of FRMs in ARMs in the early years outweigh the gains from reinvestment in later years (when annual rate floors hold ARM coupons up). This reinvestment increases cumulative ARM losses, the total cumulative loss and the aggregate capital loss by about $8 billion. Overall, these alternative reinvestment scenarios increase the $43 billion aggregate capital loss to $57 billion and $66 billion.

The taxpayers could lose less than the capital losses reported in table 8.11 for two reasons. First, $46 billion to $65 billion of shareholder capital, preferred stock, and subordinated debentures stands between the taxpayer and losses, depending on how well thrifts are recapitalized. Second, regulators could close the thrifts down shortly after interest rates start rising and liquidate their assets before the losses from even higher interest rates cumulate.

To expect such rapid behavior of regulators, especially when over half of thrift assets are in thrifts with capital amounting to less than 2 percent of assets, is unrealistic. Only a year or two of rising interest rates would wipe out that net worth, and by then the market value of existing loans would be far under water (from table 8.5, it would appear that a 2.5 percentage point increase in FRM rates would lower the market value of FRMs by 10 percent, or $40 billion). Moreover, if the thrifts are not closed down, they will be sorely tempted to take greater risks, possibly compounding the losses, as was the case in the 1980s.[12]

8.3.3 Policy Implications

This illustrates the fundamental point of the paper. If thrifts are only weakly recapitalized, taxpayers will continue to be at risk. For example, if the 1977–86 interest rate cycle were to occur today, when thrifts have very little capital or basic cash-flow income to offset reductions in cash flow caused by the increase in interest rates, taxpayers would suffer large losses. Probably 90 percent of the $88 billion to $141 billion total loss would be a capital loss, and with little capital, most of the loss would be passed through to taxpayers. A $50 billion to $100 billion loss would be expected.

In contrast, well-capitalized thrifts have clear incentives not to take significant interest rate risk because their own capital is at risk. Moreover, if they take risks and lose, the taxpayer does not take most of the hit. Finally, the

greater capital gives regulators more time to act before net worth goes negative and taxpayers take losses.

Getting an extra $60 billion to $80 billion of capital into the thrift industry is a formidable task. In fact, under current conditions it is impossible. Maybe in a decade, when the industry can again attract funds at reasonable rates owing to reduced deposit insurance premiums and a generally lower cost of funds, equity capital will be attainable. Until then, and possibly even afterward, the interest-rate-risk exposure of thrifts needs to be closely monitored.

A good first start is the new *Thrift Bulletin* (TB13) requirement that thrift boards of directors must consider the sensitivity of thrift market-value net worth to movements in interest rates of 400 basis points (although the wisdom of analyzing a parallel shift in the yield curve when long-term rates are known to move less than short rates is questionable). However, the results of these analyses should be filed quarterly with the supervisory authorities, and specific regulatory actions should be triggered for those thrifts that are increasing interest-rate-risk exposure. In the long run, something like the interest-rate-risk component of the capital requirements contained in the thrift capital requirements developed in response to the recommendations promulgated in 1987 by the Basle Committee on Banking Regulation and Supervisory Practices, may be needed.

8.4 Summary

Our examination of thrift balance sheets in early 1989 suggested an existing capital shortfall in the thrift industry of $60 billion to $79 billion. Unfortunately, the problem does not seem to be being cleaned up in a rapid, efficient manner, so the shortfall is undoubtedly greater now and will be even greater in the future (Kane 1989b). In any event, our analysis begins with assumptions regarding liquidation of nonperforming thrift assets, a 15 percent downsizing of the thrift industry, and either a $60 billion capital infusion to bring market-value capital of each thrift up to at least 1.5 percent of total assets or a $79 billion capital infusion to raise capital to 8 percent of risk-weighted assets. The industry balance sheets, so adjusted, still show the industry short funding $400 billion of long-term fixed-rate loans, a greater absolute maturity mismatch than existed in 1977, and having $325 billion in adjustable-rate loans with interest-rate caps.

A repeat of the 1977–86 interest cycle would be extremely costly to the thrift industry and, unless the industry is adequately recapitalized, ultimately to U.S. taxpayers. Thrifts would suffer cumulative cash-flow losses of $100 billion to $140 billion. About 70 percent of these losses would be due to FRMs; the rest to rate caps on ARMs. If thrifts were both profitable and well capitalized, the basic earnings of thrifts and their capital would be sufficient to cover such losses. However, under current industry conditions, taxpayers would lose $50 billion to $100 billion, and the loss would be magnified if

thrifts again took on greater risk. This illustrates a danger in letting the thrift mess drag on. Taxpayers will continue to be at substantial risk until the thrift industry is either recapitalized or liquidated.

Our analysis needs to be qualified because of the many assumptions upon which it is based. For example, we assume that all ARMs originated in the 1980s have been held in portfolio, and this is certainly not correct. For example, half of the ARMs with coupons within 3 percentage points of their life-of-loan rate cap have been originated by a single thrift that is known to sell ARMs. But these ARMs have likely been sold to other thrifts, thrifts with relatively less capital than the originating thrift. That is, the assumption that ARMs are not sold is more likely to understate the vulnerability of the thrift industry to increases in rates than to overstate the vulnerability.

Probably the most controversial assumption is that thrifts are not hedging through interest-rate swaps and caps, and so on. This assumption is obviously incorrect in its extreme form, but again we do not believe that it leads to a serious overstatement of thrift interest-rate sensitivity. Our first defense is that the thrift "experts" we have spoken with do not believe much hedging is going on. A second, and possibly related, defense is that over half of thrift assets are in institutions that have no incentive to hedge: they have few earnings to pay for hedging and little net worth to protect. Locking themselves into a negative, or minimal, net worth position is unlikely to be their preferred strategy.

Appendix

Table 8A.1 Thrift Balance Sheet and Risk Weighting, Book Value (billions of $)

	1989 Values	Risk Weighting	Risk-weighted Assets
Assets:			
Fixed-rate loans			
a. Single-family FRMs (H070 − MBSs)	134[a]	50%[d]	70
b. MBSs:GNMAs	45[b]	0	0
c. MBSs:Other	179[b]	20	36
d. Multifamily and nonresidential (H110)	68	50[e]	36
Adjustable-rate loans and second mortgage			
e. Single-family ARMs (F402)	327[a]	50[d]	169
f. Balloon and adjustable-rate loans, including construction loans, AED loans, etc. (H030 − F402)	214[a]	50[d]	113
g. Second mortgage loans, largely home equity loans (H150)	16	100[f]	17
Intermediate term			
h. Consumer loans, net of loans on deposits (H190 − A170) (plus some seconds)	56[c]	100	56
i. Other investments (including junk bonds, CMOs, and REMICs) (H270 − A370 − A382 − A400)	122[c]	100	122
Short term			
j. Cash and demand deposits (A360)	16	0	0
k. U.S. government and agencies (A370)	37	20	7
l. Commercial loans and accrued interest (H230 + A390)	34[c]	100	34
m. Equities except FHLB-FHLMC (A382)	4	100	4
n. Nonfinancial assets, net of valuation allowances (A800 −H310 − A360 − A390 − A525 − C992)	129	119[f]	153
Total assets, net of deferred losses and loans on deposits	1,381 (1,388)		810 (824)[j]
Liabilities			
o. Deposits (B012 + B014 + B016 + B018)[g]	989		
p. Other short-term borrowing, including commercial bank loans (B030), Reverse repurchase agreements (B040), Consumer retail repurchase agreements (B050), Net demand deposit overdrafts (B060 − A170), Commercial paper (B070), Other liabilities (B110 through B200)	132		

(continued)

Table 8A.1 (continued)

	1989 Values	Risk Weighting	Risk-weighted Assets
Liabilities			
q. Advances plus other borrowing (B020 + B100)[h]	196		
r. Long-term liabilities, other than those listed above (B800 − [deposits + other short-term borrowing + advances + A170])	17		
s. Subordinated debentures (B310 + B312)	5		
t. GAAP net worth[k]	42		
Total liabilities and net worth	1,381		

Source: Office of Thrift Supervision, quarterly *Thrift Financial Report*. In sections A, B, C, F and H of the *Report*, all data are as of March 1989.

Sections A and B provide information on balance sheet items. Section C provides information on modified equity capital items and adjustments to modified equity capital for institutions reporting on a GAAP basis. Section F (supplemental monthly data) reports on activity during the month and balances of loans and commitments outstanding as of the end of the month. Section H (maturity and yield/cost information) provides maturity and yield data on conventional mortgages secured by 1–4 dwelling units with fixed rates, balloon and adjustable-rate mortgage loans, other mortgage loans and contracts, and investment securities.

Note: We thank Carol Wambeke of the Office of Thrift Supervision for providing us with asset risk-weighting.

[a]Net of share of valuation allowances for mortgages (A129+A131).

[b]MBSs are divided into GNMAs and others based on a survey of commercial banks and savings and loan associations (see Nothaft 1989).

[c]Net of share of valuation allowances for nonmortgages (A270 + A280 + A290).

[d]Delinquent loans are in the 100 percent bucket; in general, delinquent loans equal loans × (delinquent mortgage loans [FDQML]/net mortgage loans & contracts [ATMLCN]).

[e]50 percent weight for properties with under 36 units; 100 percent weight for properties with 36 or more units. We follow the Office of Thrift Supervision in assuming that all properties have under 36 units. Delinquent multifamily and nonresidential loans are in the 100 percent bucket.

[f]Delinquent loans are in the 200 percent bucket.

[g]In 1986, 96 percent of deposits had maturities of 3 years or less; 4 percent had maturities between 5 to 10 years.

[h]In 1986, 70 percent of Federal Home Loan Bank advances had maturities between 2 to 10 years; 76 percent of other borrowings had maturities between 3 to 10 years. Average duration of Federal Home Loan Bank advances is roughly 2 years.

[i]See table 8.2.

[j]Numbers in parentheses represent total assets (risk-based assets), including loans on deposits and deferred losses.

[k]Also includes a minuscule amount of net worth certificates (B320 + B330 + B340 + B350 − B380) and accumulated annual income payments, not due and payable (B360).

Table 8A.2 Measurement of Regulatory Capital (billions of $)

	1989
Core capital (tier 1):	
GAAP net worth	42
− Excluded goodwill (A544 − included goodwill)[a]	11
− Perpetual preferred stock (C012)	2
Total	29
Memo:	
Required core capital[b]	41
Supplementary capital (tier 2):	
Subordinated debentures (B310 + B312)	
+ Perpetual preferred stock (CO12)	
+ Qualifying pledged deposits (C958)	
+ Valuation allowances[c]	
+ Other supplementary capital[d]	
Total, not to exceed core capital	7
RAP capital[e]	36
Memo:	
Tangible capital (core capital − A544)	9
Required tangible capital[f]	20
Required risk-weighted capital at end of 1992[g]	66

Source: Office of Thrift Supervision, *Thrift Financial Report*, March 1989, Section C.
[a]Included goodwill equals min[total goodwill, 0.015*tangible assets].
[b]Required core capital equals 3 percent of tangible assets.
[c]Included valuation allowance equals min[C960, 0.015*risk-weighted assets].
[d]Other supplementary capital includes capital certificates (B320 + B330 + B340 + B350) and accumulated annual income payments, not due and payable (B360).
[e]RAP capital equals core capital plus supplementary capital, where supplementary capital may not exceed core capital.
[f]Required tangible capital equals 1.5 percent of tangible assets.
[g]8 percent of risk-weighted assets.

Table 8A.3 Distribution of ARMs by Size of Teaser, Years Until Repricing, and Annual Rate Caps, 1986–1989 (% of ARMs)

	1-year and less Annual Cap		3-year and more Annual Cap		
Size of Teaser	1%	2%	1%	2%	Total
1986					
<0.5%	8.52	28.01	0.43	4.89	41.85
0.5–1.5%	3.37	18.52	0.32	0.86	23.07
1.6–2.5%	2.83	25.94	0.02	0.47	29.26
>2.5%	1.45	4.27	0.01	0.06	5.79
Total	16.17	76.74	0.78	6.28	100.0
Number of loans	1,095	5,195	54	425	6,769

(continued)

Table 8A.3 (continued)

Size of Teaser	1-year and less Annual Cap		3-year and more Annual Cap		Total
	1%	2%	1%	2%	
1987					
<0.5%	8.18	24.83	0.39	5.63	39.03
0.5–1.5%	2.22	8.51	0	1.86	12.59
1.6–2.5%	6.96	28.84	0	1.54	37.37
>2.5%	0.79	9.34	0.01	0.91	11.03
Total	18.15	71.50	0.40	9.94	100.0
Number of loans	2,860	11,265	63	1,566	15,754
1988					
<0.5%	8.22	26.74	0.36	4.40	39.72
0.5–1.5%	1.43	3.26	0	1.07	5.76
1.6–2.5%	10.06	24.95	0.01	1.12	36.14
>2.5%	2.47	15.69	0	0.22	18.38
Total	22.18	70.64	0.37	6.81	100.0
Number of loans	4,649	14,814	78	1,428	10,969
1989					
<0.5%	6.69	26.46	0.36	4.13	37.64
0.5–1.5%	2.45	8.43	0.02	0.80	11.79
1.6–2.5%	5.28	19.34	0	1.57	26.19
>2.5%	2.98	21.09	0	0.40	24.47
Total	17.40	75.32	0.38	6.90	100.0
Number of loans	2,350	10,176	52	933	13,511

Source: Federal Housing Finance Board, Mortgage Interest Rate Survey, May–July of 1986–89.

Notes

1. Kane (1989b, table 3–4) estimates a $55 billion loss at thrifts with negative net worth (as measured by generally accepted accounting principles) and tangible-insolvent thrifts as of 30 September 1988, a loss that was increasing by over $1 billion a month.

2. See Kane (1989a, chap. 3) for an enlightening discussion of the development of the debacle.

3. For a discussion of the basic profitability problems of solvent thrifts, see Hendershott (1989).

4. Book net worth exceeds GAAP capital to the extent that the appraised value of fixed assets exceeds their book value.

5. Bovenzi and Murton (1988) break down the total loss on assets at commercial banks into four asset categories: 1) doubtful or loss; 2) substandard; 3) nonclassified risk assets; and 4) income earned but not collected. The estimated losses (per dollar) for each of these four asset categories are $0.92, $0.61, $0.20, and $0.20, respec-

tively. We have assumed that REO and REH are doubtful or loss assets, and equity in service corporations (which is often used to hide underwater assets) and other assets are nonclassified risk assets.

6. Thrifts hold $7 billion in interest-only mortgages, but also $4 billion in principal-only mortgages. In addition, they hold $16 billion in collateralized mortgage obligations (CMOs), but we do not know the maturity of these. We have classified the aggregate of all these assets as intermediate-term loans. See Kaufman (1984) for a primer on hedging the market value of net worth, and Breeden and Giarla (1988) for an advanced treatment.

7. With one exception: the initial coupon on a teaser ARM is set below all of these rates.

8. For net intermediate assets, the increase in interest income per dollar of assets is

$$\Delta r_t^{INT} = r_t^{INT} - r_{t-1}^{INT},$$

where $r_t^{INT} = \frac{1}{3}(r_t + r_{t-1} + r_{t-2})$. The loss of interest income on intermediate assets, INTER, over the twenty-year period is

$$L_{INT} = \sum_{t=1}^{20}(\Theta_t \Delta r_t - \Delta r_t^{INT})\text{INTER}.$$

This loss is trivial because thrifts have only $12 billion of net intermediate assets.

9. In cases where the capital loss is zero for individual thrifts, e.g., in early periods of the simulation for well-capitalized thrifts, a negative capital loss is set equal to zero, i.e., positive earnings for such thrifts are presumed to be paid out as dividends.

10. In the loss calculations for FRMs, equation (1) was modified to incorporate variable FRM repayment rates.

11. This sounds like a recommendation that thrifts "grow out of the problem," a policy advocated by many in the early 1980s. Such a policy works if (1) the growth is investment in safe long-term assets (long-term Treasuries would be better than FRMs) and (2) interest rates do indeed come back down.

12. For discussion of the perverse incentives facing many thrift managers in the 1980s, see Kane (1989a, chap. 2), Barth, Bartholomew, and Labich (1990), and Benston, Carhill, and Olasov, in this volume.

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