

# The Quarterly Review Of Interest Rate Risk



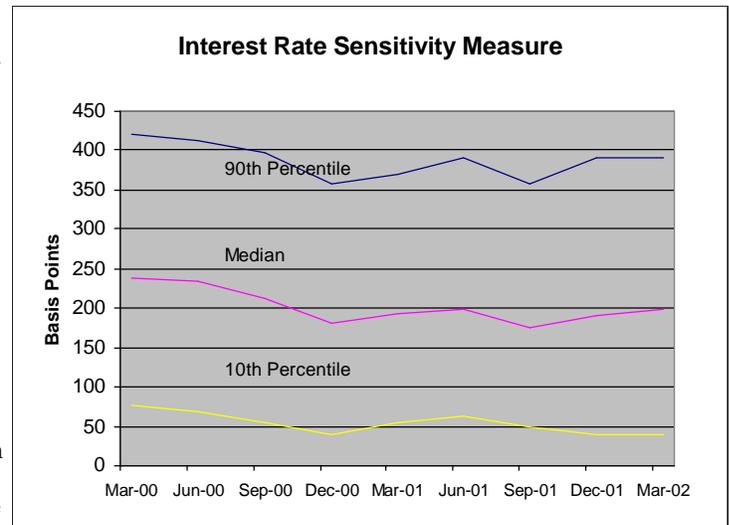
Office of Supervision,  
 Economic Analysis Division

## Median Sensitivity Rises in the First Quarter

Median thrift sensitivity rose to 198 basis points in the first quarter, up from 190 basis points in December. This increase reflects the rise in interest rates between the fourth quarter of 2001 and the first quarter of this year.

Both the median pre- and post-shock Net Portfolio Value (NPV) ratios rose between the fourth and first quarters. In addition, the first quarter saw the number of thrifts with high interest rate risk fall to 10, down from 17 thrifts in the previous quarter.

See details inside,



starting on page 4.

### Special points of interest:

- 30-Yr mortgage rate rises
- Yield curve becomes more steeply sloped
- First quarter sees median interest rate sensitivity rise
- Median pre- and post-shock NPV ratios rise
- Differences in Published Spot and Implied Forward Rates
- CMR Reporting of Deposit Information

## Differences in Published Spot and Implied Forward Rates

Each quarter, we receive inquiries regarding differences between the Treasury spot and implied forward interest rates reported in the OTS Price Tables and those reported by Bloomberg. The explanation for the rate differences rests primarily on differences in the methodologies used to produce the theoretical zero-coupon, or spot rate, curves.

The Treasury spot rate curve shows the interest rate yields on Treasury securities that pay no intermediate coupons. Because Treasury spot yields are not directly observable for most maturities, a yield curve of this type must be constructed. Further com-

plicating the problem is the fact that there is only imperfect and incomplete price quote information available to construct the spot curve.

In order to run the Net Portfolio Value (NPV) Model, it is necessary to first have a complete spot yield curve along with its implied forward rate curve. These curves must cover 30 years in monthly increments as of the end of the quarter for which the model is used to produce NPV estimates.

The spot yield curve must be produced from whatever data one can get on observable yields on Treasury bills, notes, and bonds. Because there is no

single source of data on the underlying yields, and no single methodology to produce a spot yield curve, the spot curves generated by different entities may differ. For example, OTS follows its own methodology, Bloomberg follows its own, and the major bond trading houses, such as Lehman and Bear Stearns have their own proprietary methodologies.

Thus, construction of the spot yield curve can be viewed as an art. At the same time, the calculation of implied forward rates from a given spot curve is merely a matter of simple algebra, as we will see below.

(Continued on page 2)

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## OTS and Bloomberg Implied Forward Rates (continued)

(Continued from page 1)

This being the case, it is in the construction of the spot yield curve that we should find the roots of any significant differences among the implied forward rates observed from different sources. The generation of implied forward rates from spot yields will magnify any differences in those spot rates.

Because different approaches are used to produce a complete spot rate curve, the implied forward rates that Bloomberg and OTS report are different. Indeed, these differences can be substantial. Exhibit 1 presents the standard formula used to generate implied forward rates from a complete set of spot rates.

In producing the implied forward rates used by the NPV Model, **OTS** does the following: First, Constant Maturity Treasury rates (quoted as yields to maturity) for key maturities are obtained from the Federal Reserve Board's Statistical Release H.15. Second, yields to maturity for those maturities for which market quotes are not observed are estimated using a statistical interpolation technique known as "cubic splining."

By definition, splines are an interpolation technique that can be used to fit a yield curve around known, observed points. Thus, in developing a complete monthly spot yield curve, most yields will be estimated in this way.

With cubic splining, a third-order polynomial is used to estimate the unobservable yields to maturity. (See the *NPV Model Manual* on the OTS web site for de-

### Exhibit 1. Implied Forward Rates

$$f_{t-1,t} = \frac{(1 + z_t)^t}{(1 + z_{t-1})^{t-1}} - 1$$

where

$f_{t-1,t}$  = the implied forward rate from the end of period  $t - 1$  to period  $t$

$z_t$  = the yield to maturity on a zero coupon treasury security with a maturity of  $t$  periods

$z_{t-1}$  = the yield to maturity on a zero coupon treasury security with a maturity of  $t - 1$  periods

tails.)

Third, using the complete set of yields to maturity thus derived, the spot rate curve is estimated assuming par and using "bootstrapping." Bootstrapping is a technique used to generate spot rates from the yields to maturity of coupon-bearing instruments. The specific variant of this technique used by OTS is the variable B-knot,

cubic spline. (See Frank Fabozzi, *Valuation of Fixed Income Securities*, 1994 for details on bootstrapping spot yield curves.)

Once a complete set of spot rates is obtained, then the formula presented in Exhibit 1 can be used to generate implied forward rates for particular horizons, say one-month, for example.

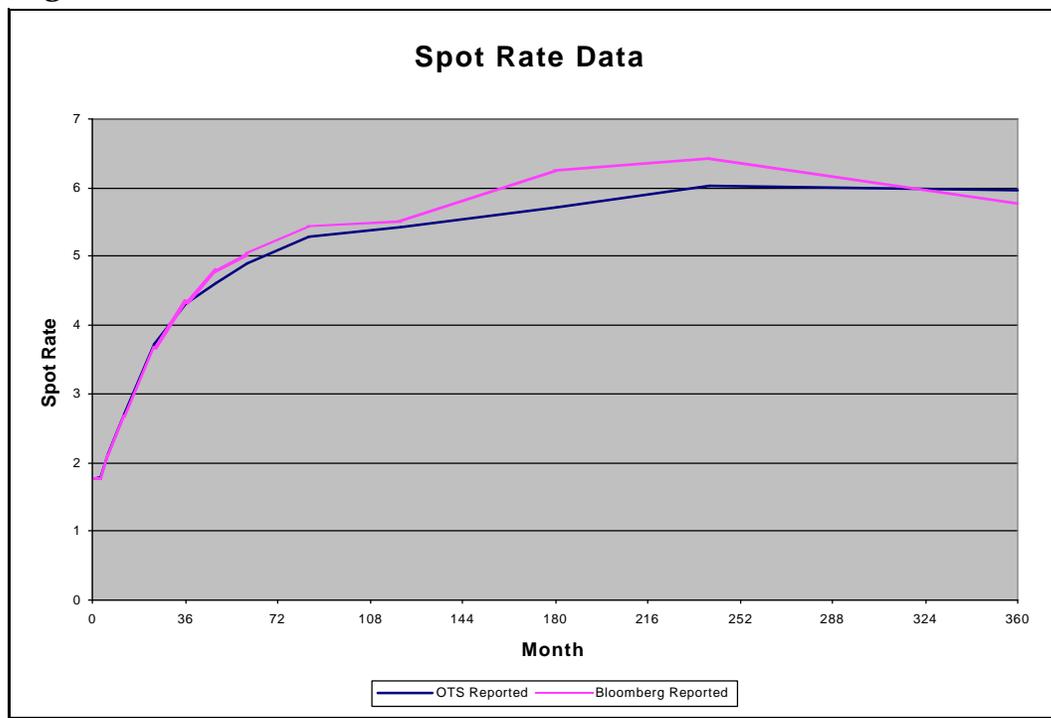
A different approach to

produce implied forward rates is used by **Bloomberg** in its default terminal settings. First, Bloomberg obtains observed Treasury yields to maturity for key maturities using an internal database. Second, from these observed yields to maturity, Bloomberg calculates what it terms "implied spot rates."

Third, in order to generate a complete set of spot rates, Bloomberg, in its default screen settings—which, at this writing, is all that is apparently available to the end-user for the generation of Treasury spot yields—uses a linear interpolation between these implied spot rates. This interpolation approach involves fitting straight lines between the implied spot rates and then reading the estimated values from the fitted straight lines. Fi-

(Continued on page 3)

Figure 1



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nally, Bloomberg uses the formula in Exhibit 1 to produce implied forward rates.

Figure 1 on the previous page presents plots of the spot rate curves reported by OTS and Bloomberg for the end of the first quarter 2002. The differences between the two spot rate curves can be attributed to two factors. The first is that the samples of Treasury price quotes used to generate the yields to maturity underlying the spot rates differ. And second, different approaches are used to populate the entire spot rate curve.

For comparison purposes, Figure 2 presents plots of the OTS one-month implied forward rate curve used by the NPV Model and that found on Bloomberg using the linearly interpolated spot rates. The OTS forward rate curve is produced from a complete spot

yield curve which in turn, is based on the smoothed, or splined, end of quarter yield to maturity data produced from rates reported by the U.S. Treasury for the quarter ended March 2002. The Bloomberg implied Treasury forward rate curve is obtained using the Forward Yield Curve Analytics (FWCV) function in Bloomberg for the quarter ended March 2002, using yield curve option number 500.

The two plots of the implied forward rate curves display markedly different behavior. The erratic, piece-wise linear pattern of Bloomberg's implied forward rates stems directly from the linear interpolation of its implied spot rates.

Linearly interpolated spot rate curves will produce saw tooth forward rate curves. This stems from the fact that, with lin-

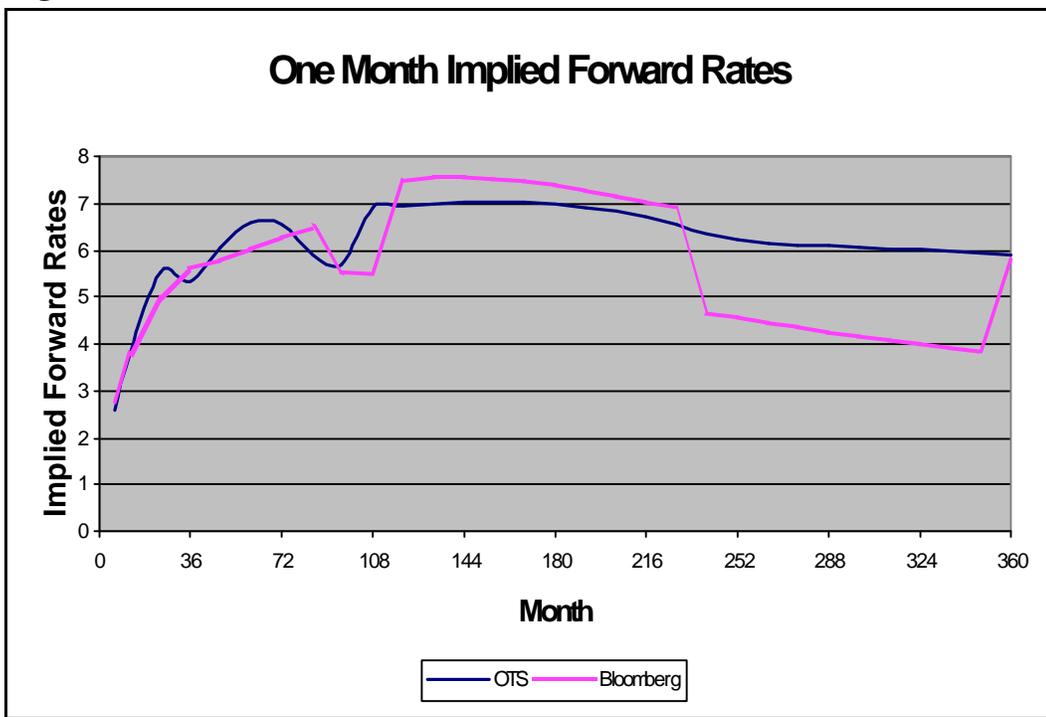
ear interpolation, sudden changes in yields occur for small changes in maturity. Consistent with this point, Bloomberg's implied forward rate curve exhibits discontinuities at each of the observed yields to maturity.

In contrast, the OTS one-month implied forward curve does not have the discontinuities or saw tooth appearance displayed by the Bloomberg forward rate curve. This stems from the fact that the OTS spot yield curve is derived from smoothed, or splined, yields to maturity.

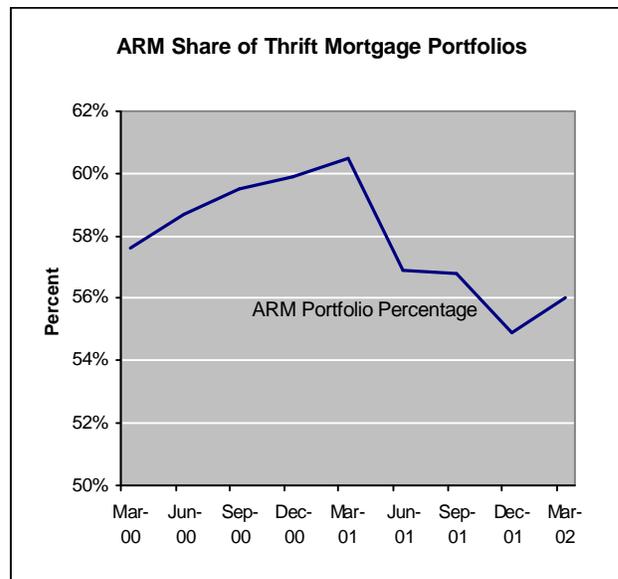
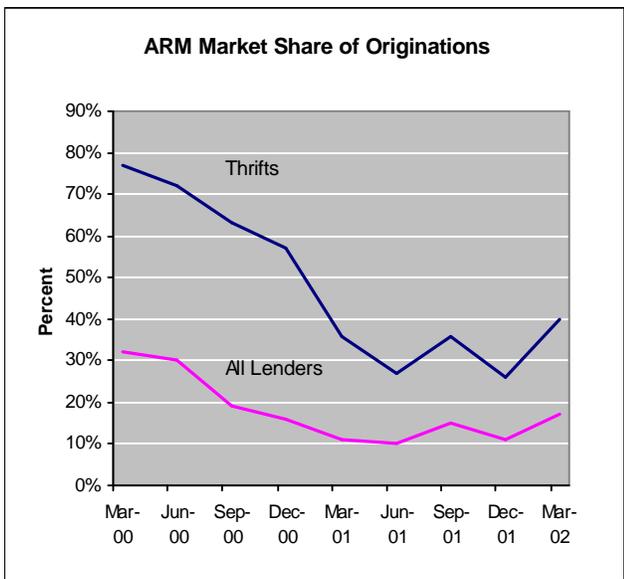
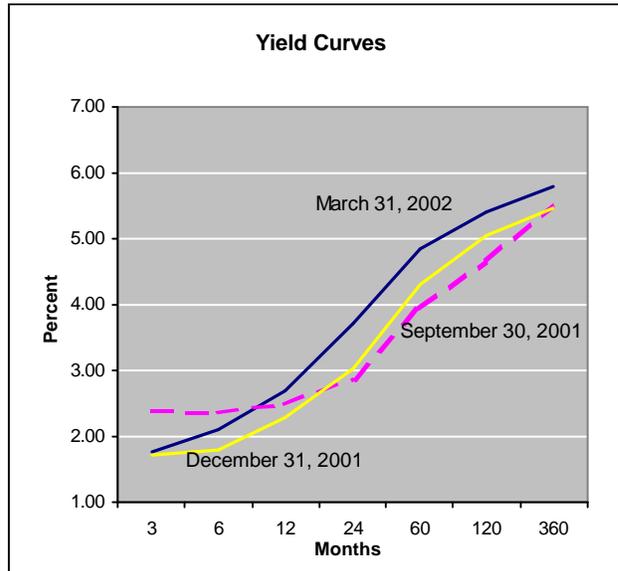
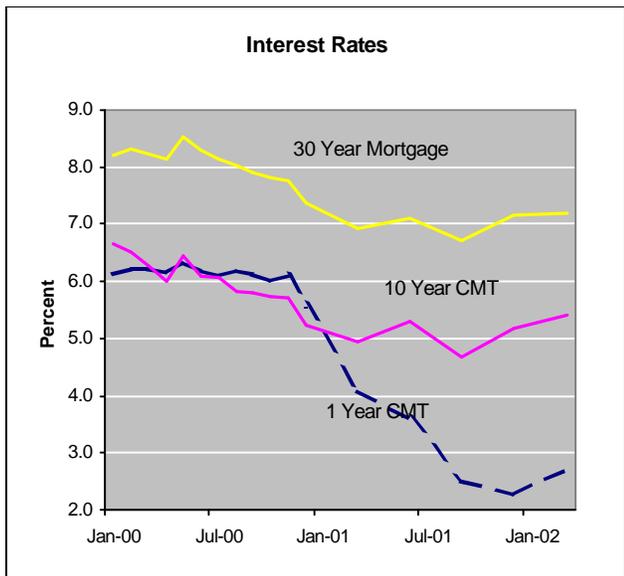
In sum, although linear interpolation has its appeal, i. e., it is easily understood and implemented, spot rates developed from this procedure will produce highly irregular implied forward rates. In order to avoid problems associated with using saw-toothed implied forward rates in dis-

counting cash flows and valuing portfolios, OTS uses a methodology to produce spot rates that generates a smooth implied forward curve. •

**Figure 2**



## Interest Rates and ARM Market Share



(Continued from page 1)

Treasury rates rose at all maturities between the fourth and first quarters. In addition, the 30-year mortgage rate edged up slightly to 7.18 percent at the end of the first quarter from 7.16 at the end of the fourth quarter.

The changes in interest rates between the fourth and first quarters allowed a favorable lending environment to persist for yet another quarter. As a result of a more steeply sloped yield curve, thrifts saw their net interest margins again rise. The

industry's average net interest margin improved to 318 basis points in the first quarter, up from 312 basis points in the prior quarter.

The ARM share of total thrift mortgage originations rose to 40 percent, up from 26 percent in the prior quarter. Along with the relative rise in ARM originations, the share of ARM mortgages held in portfolio climbed to 56 percent in the first quarter.

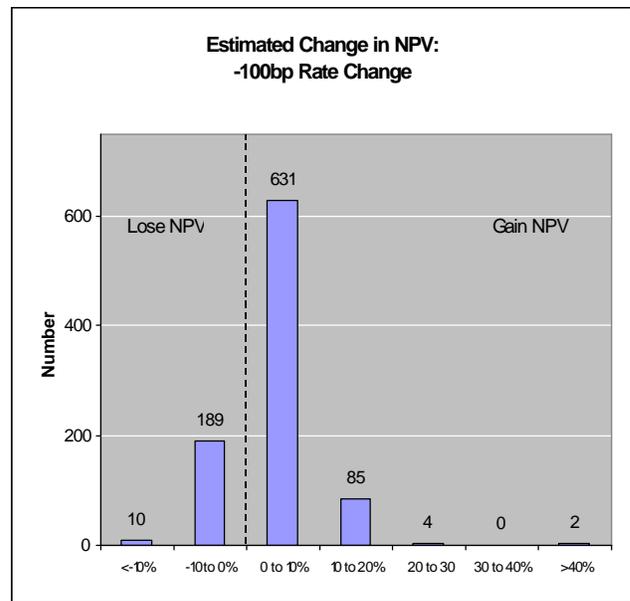
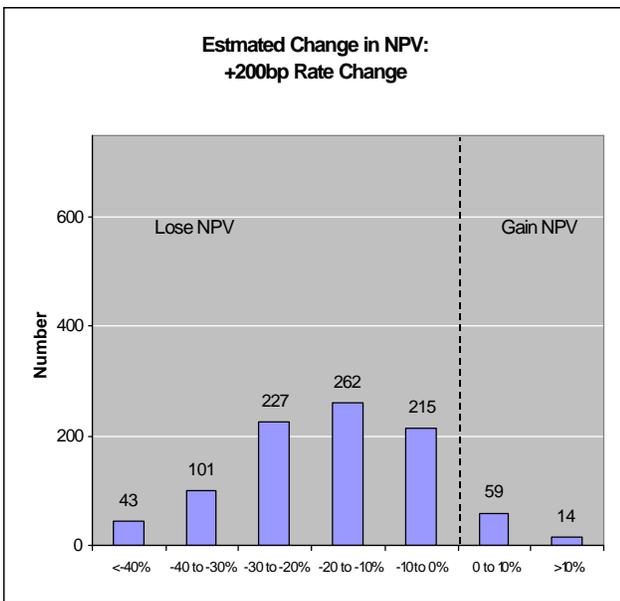
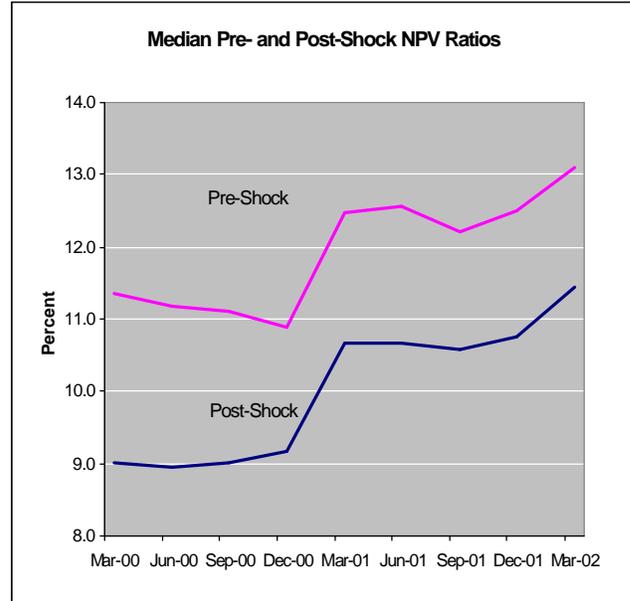
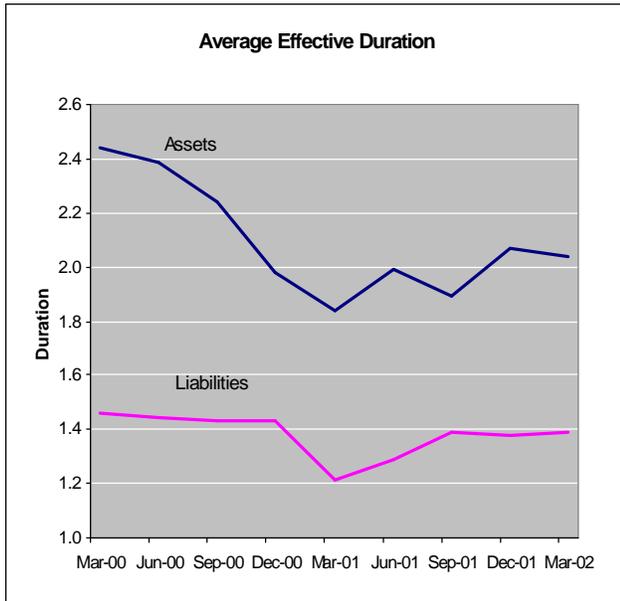
The first quarter saw an easing in mortgage originations due to the increase in rates. First-quarter 1-4

family mortgage originations by thrifts stood at \$97.4 billion, down from \$110.4 billion in the fourth quarter. Total mortgage originations in the first quarter were at a level of \$ 110.9 billion, down from \$124.2 billion in the fourth quarter.

Thrifts' share of all 1-4 family originations was 22.9 percent in the first quarter, up from 17 percent in the fourth quarter. The first quarter witnessed a slight decrease in U.S. home ownership, falling to 67.8 percent from 68 per-

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## Duration and NPV Sensitivity Measures



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cent by quarter-end.

Refinancing activity of all mortgages accounted for 38.9 percent of thrift originations in the first quarter, down from 41 percent in the fourth quarter. This decrease is consistent with the mortgage refinancing activity of all lenders, with the rate falling to 55 percent in the first quarter, down from 70 percent in the prior quarter.

First-quarter thrift industry earnings rose to a record of \$3.05

billion, up from \$2.93 billion in the fourth quarter.

The industry's average effective duration of assets effectively remained the same, falling only slightly from 2.07 to 2.04 between the fourth and first quarters.

The industry's average effective duration of liabilities also remained largely the same, rising slightly to 1.39 in the first quarter, up from 1.38 in the prior quarter.

The median pre-shock NPV ratio for the industry rose from 12.5 percent to 13.1 percent between

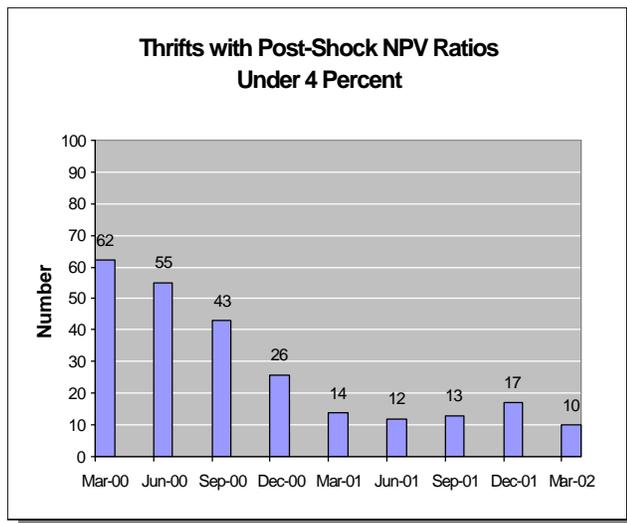
the fourth and first quarters.

The median post-shock NPV ratio rose to 11.4 percent in the first quarter, up from 10.8 percent in the prior quarter.

At the end of the first quarter, a 200 basis point increase in rates would result in a loss in net portfolio value for 848 thrifts, while 73 thrifts would see their net portfolio values rise. In the event that rates fell by 100 basis points, 722 thrifts would see their net portfolio values rise, while 199 thrifts would see a

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## Interest Rate Risk Measures



	Ratio of NPV to Assets		% Change in NPV	
	Dec-01	Mar-02	Dec-01	Mar-02
<b>+300</b>	8.2	8.2	-25%	-29%
<b>+200</b>	9.1	9.4	-15%	-17%
<b>+100</b>	9.9	10.4	-6%	-6%
<b>Base</b>	10.3	10.9	0	0
<b>-100</b>	10.4	11.3	2%	5%
<b>-200</b>	N/A	N/A	N/A	N/A
<b>-300</b>	N/A	N/A	N/A	N/A

	Under 100bp	101-200bp	201-400bp	Over 400bp	Total
<b>Over 10%</b>	195	118	185	44	542
<b>6% to 10%</b>	88	81	151	25	345
<b>4% to 6%</b>	1	4	19	8	32
<b>Below 4%</b>	2	2	8	5	17
<b>Total</b>	<b>286</b>	<b>205</b>	<b>363</b>	<b>82</b>	<b>936</b>

	Under 100bp	101-200bp	201-400bp	Over 400bp	Total
<b>Over 10%</b>	215	126	211	50	602
<b>6% to 10%</b>	48	69	145	23	285
<b>4% to 6%</b>	3	2	14	5	24
<b>Below 4%</b>	0	1	3	6	10
<b>Total</b>	<b>266</b>	<b>198</b>	<b>373</b>	<b>84</b>	<b>921</b>

Minimal   Moderate   Significant   High

Minimal   Moderate   Significant   High

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decrease in their net portfolio values.

The number of thrifts with a post-shock NPV ratio below 4 percent fell to 10. This represents the first quarterly decrease since June 2001.

With a 200 basis point increase in interest rates, the thrift industry would lose 17 percent of its net portfolio value. This net portfolio loss is up from 15 percent in the previous quarter, and is

consistent with the rise in median sensitivity.

The percentage of thrifts with a post-shock NPV ratio over 6 percent increased between the fourth and first quarters. In the first quarter, the number of such thrifts comprised 96.3 percent of the industry compared to 94.8 percent in the prior quarter.

The number of thrifts with a post-shock NPV ratio below 6 percent fell to 34 in the first quarter, down from 49 in the fourth quarter.

ter.

The number of thrifts with a sensitivity of 200 basis points or less decreased to 464 in the first quarter, down from 491 in the fourth quarter. The number of thrifts with over 400 basis points in sensitivity rose to 84 in the first quarter, up from 82 in the fourth quarter.

This result is consistent with the increase in rates between the fourth and first quarters. Despite

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the rise in interest rates, the number of thrifts with high interest rate risk fell from 17 to 10 between the fourth and first quarters. This decrease occurred because the increase in NPV between the fourth and first quarters was greater than the increase in sensitivity.

As was the case in the fourth quarter, due to the abnormally low short term interest rates prevailing at the end of the first quarter of 2002, the rate shocks for producing sensitivities and post-shock NPVs are +200/-100 bps. •

## CMR Reporting of Deposit Information

Beginning with the March 2002 reporting cycle, previously optional deposit information on Schedule CMR must now be reported by all thrifts.

The reporting change makes the following fields required. For fixed-rate, fixed-maturity deposits, thrifts must now report information on early withdrawals during the current quarter. For non-maturity deposits, thrifts must now report balances in new accounts. •

## Glossary

**Pre-Shock NPV Ratio:** Equity-to-assets expressed in present value terms (i.e., base case NPV divided by base case present value of assets).

**Post-Shock NPV Ratio:** Equity-to-assets ratio, following an adverse 200 basis point interest rate shock (assuming a normal interest rate environment), expressed in present value terms (i.e., post-shock NPV divided by post-shock present value of assets). Also referred to as the exposure ratio.

**Sensitivity Measure:** The difference between Pre-shock and Post-shock NPV Ratios (expressed in basis points).

**Estimated Change in NPV:** The percentage change in base case NPV caused by an interest rate shock.

**Duration:** A measure of the price sensitivity of a financial instrument to changes in yield. The higher the duration, the greater the price sensitivity. For example, an asset with duration of 1.6 will appreciate in value by about 1.6 percent for one percentage point (100 basis points) decline in yield.

**NPV Model:** Measures how six hypothetical changes in interest rates (three successive 100 basis point increases and three successive 100 basis point decreases, assuming a normal interest rate environment) affect the estimated market value of a thrift's net worth.

**Kurtosis:** A statistical measure of the tendency of data to be distributed toward the tails, or ends, of the distribution. A normal distribution has a kurtosis statistic of 0.

**Skewness:** A statistical measure of the degree to which a distribution is more spread out on one side than the other. A distribution that is approximately symmetric will have a skewness statistic close to 0.

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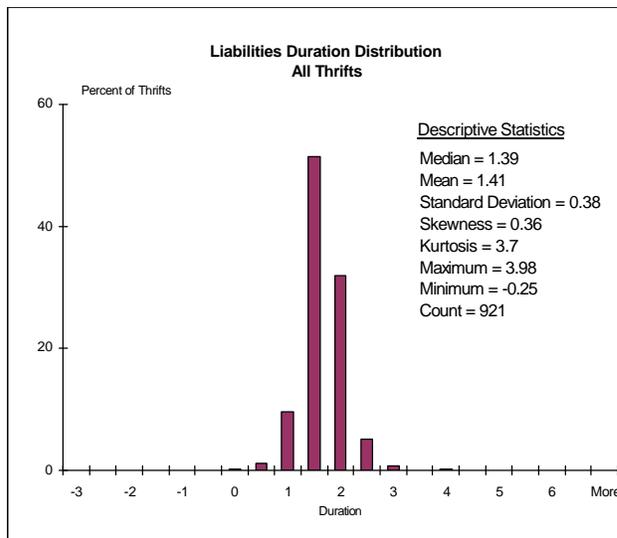
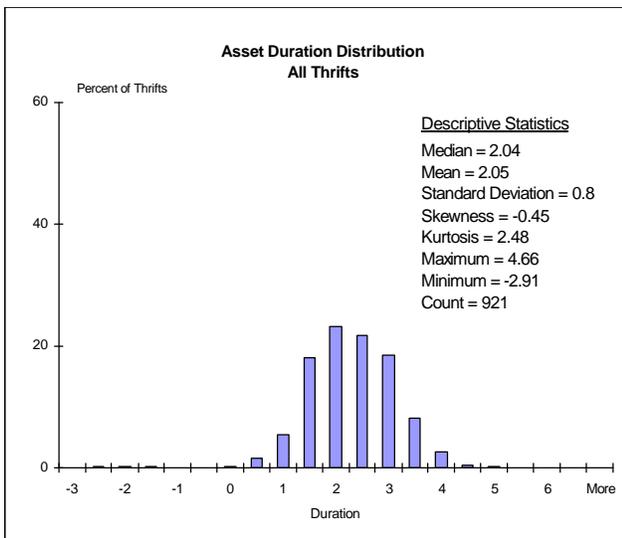
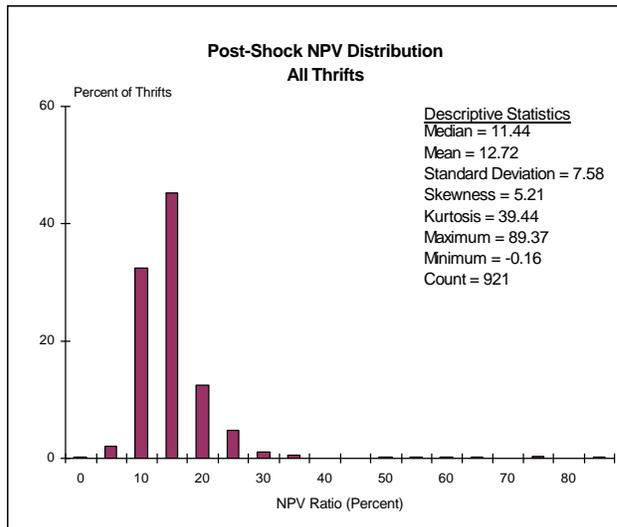
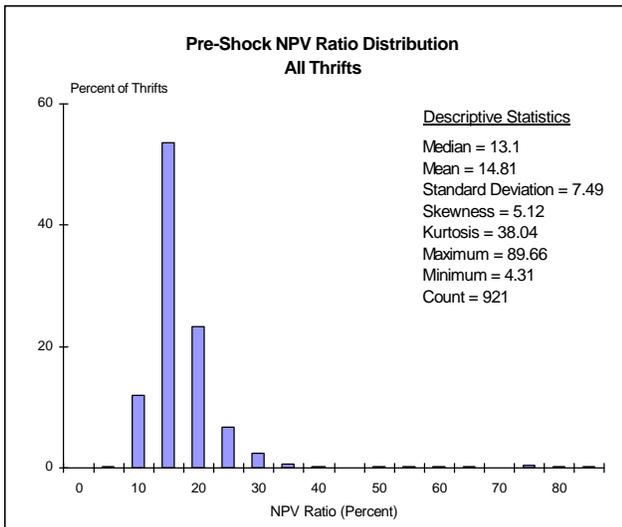
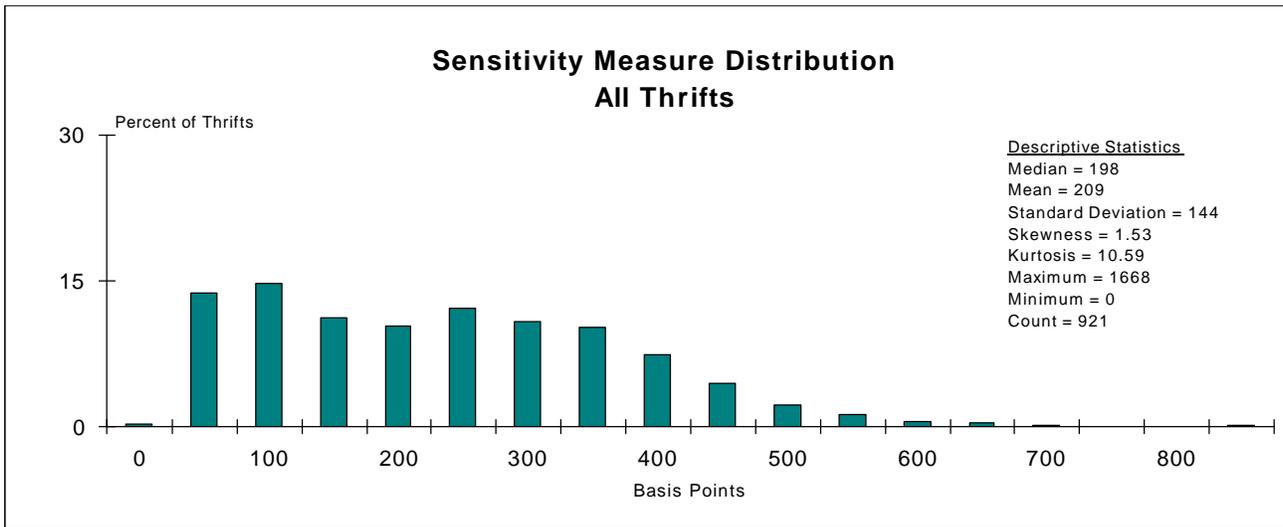
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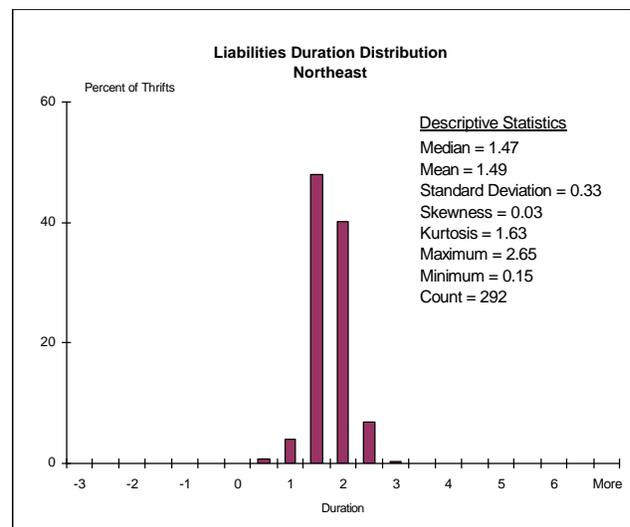
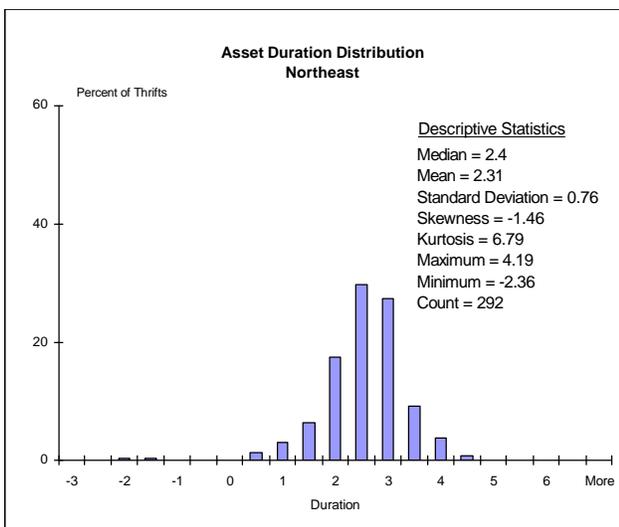
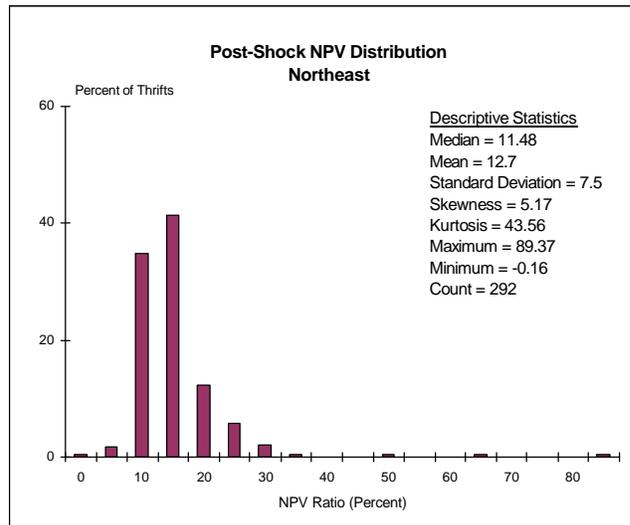
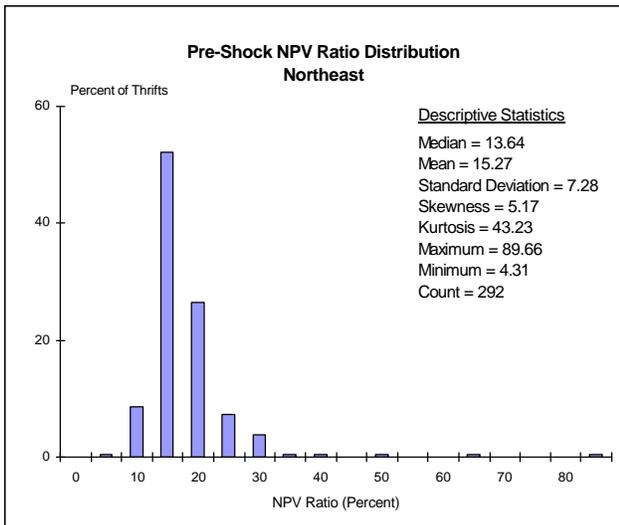
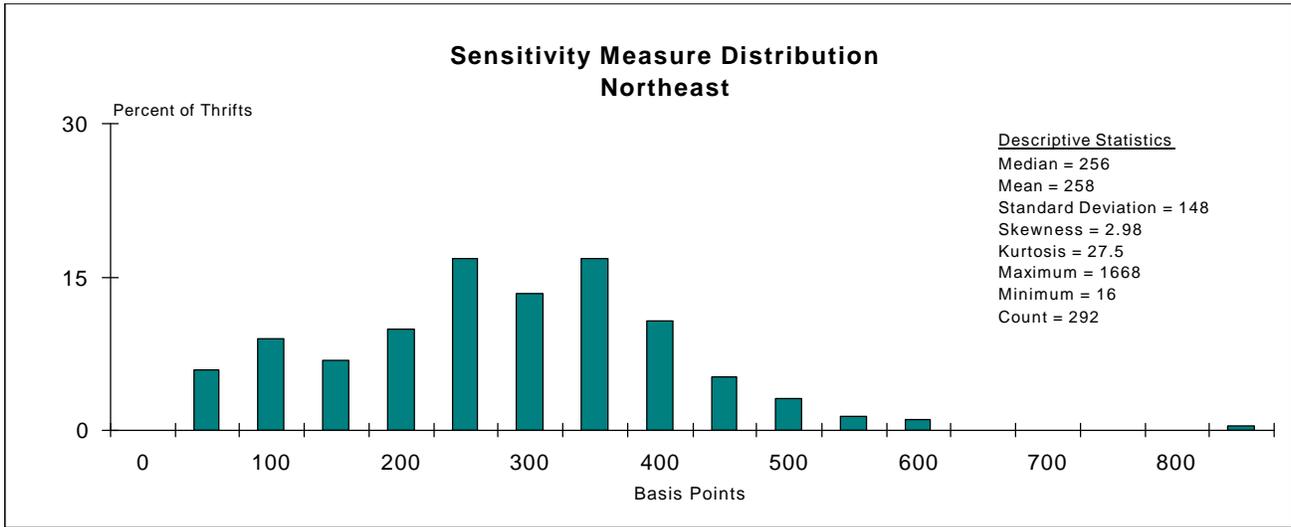
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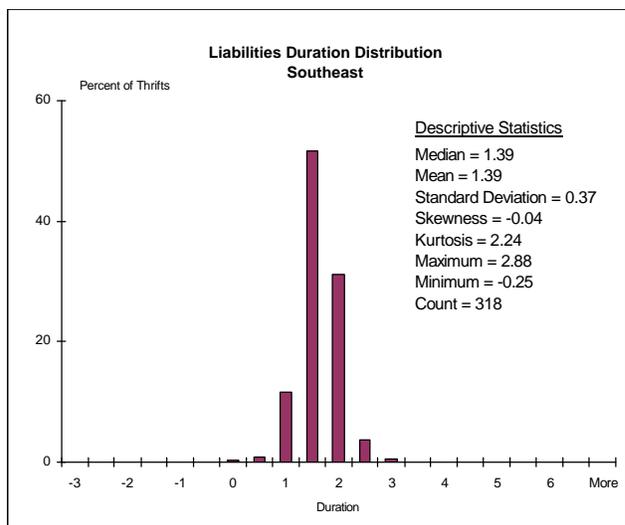
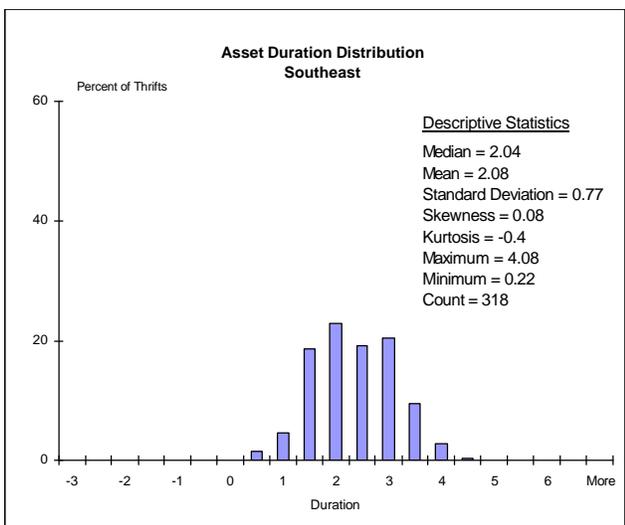
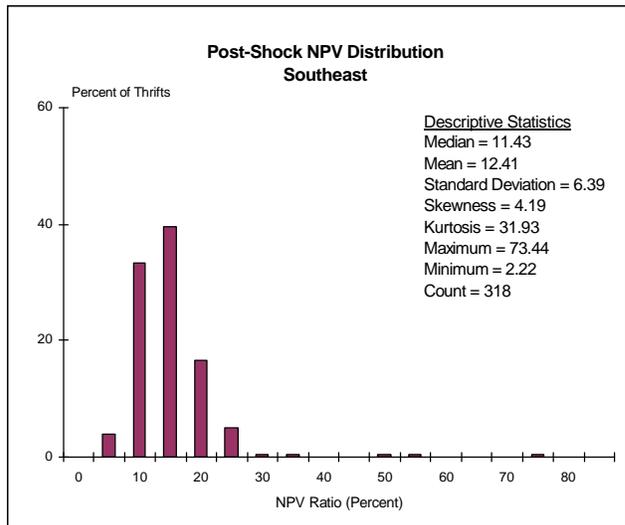
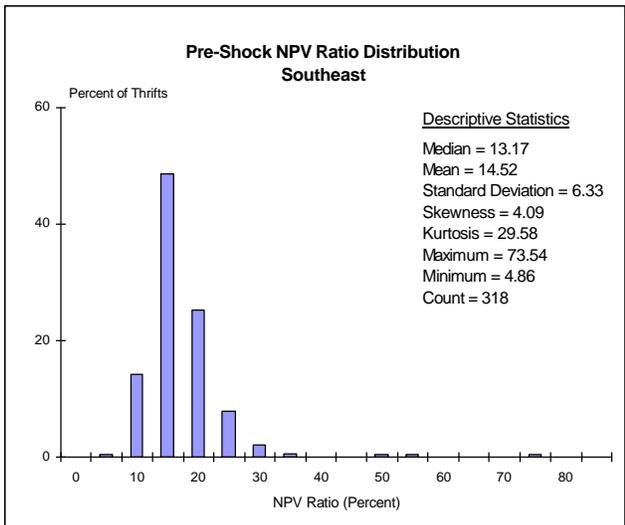
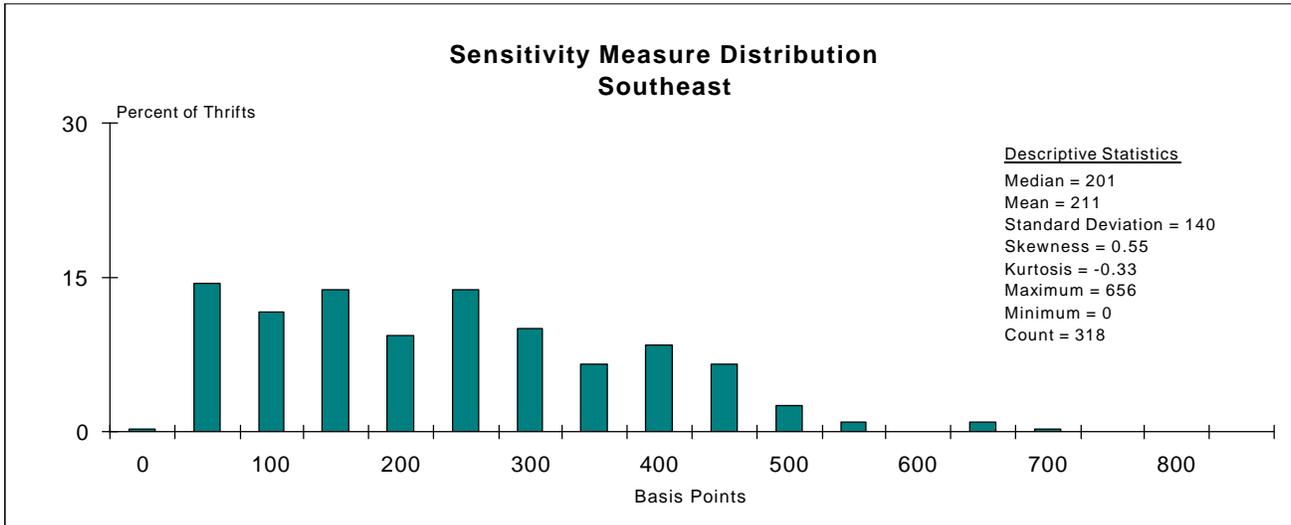
## Appendix A – All Thrifts



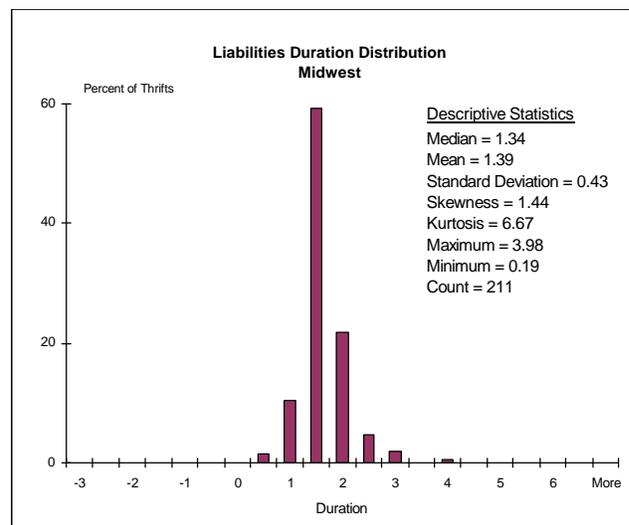
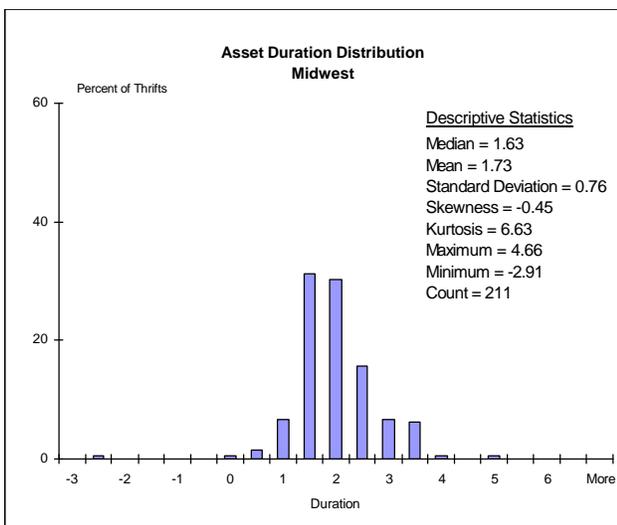
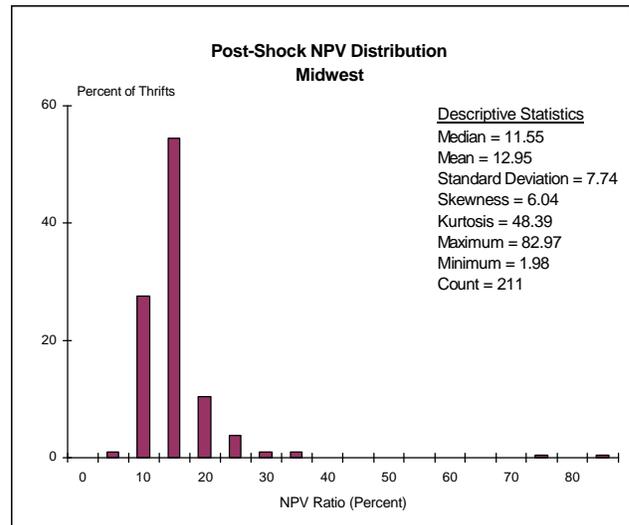
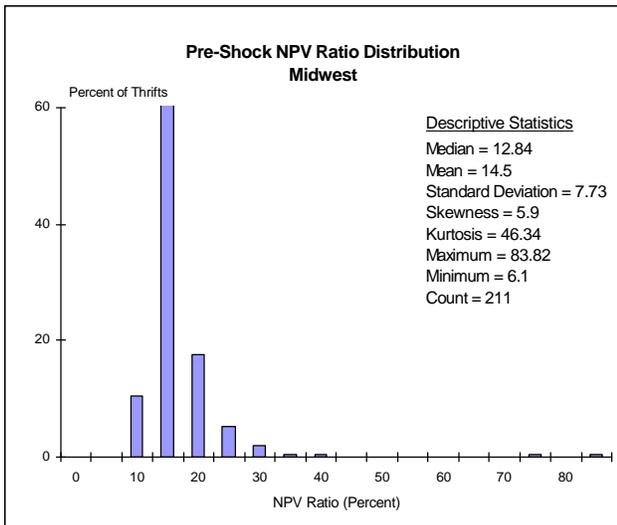
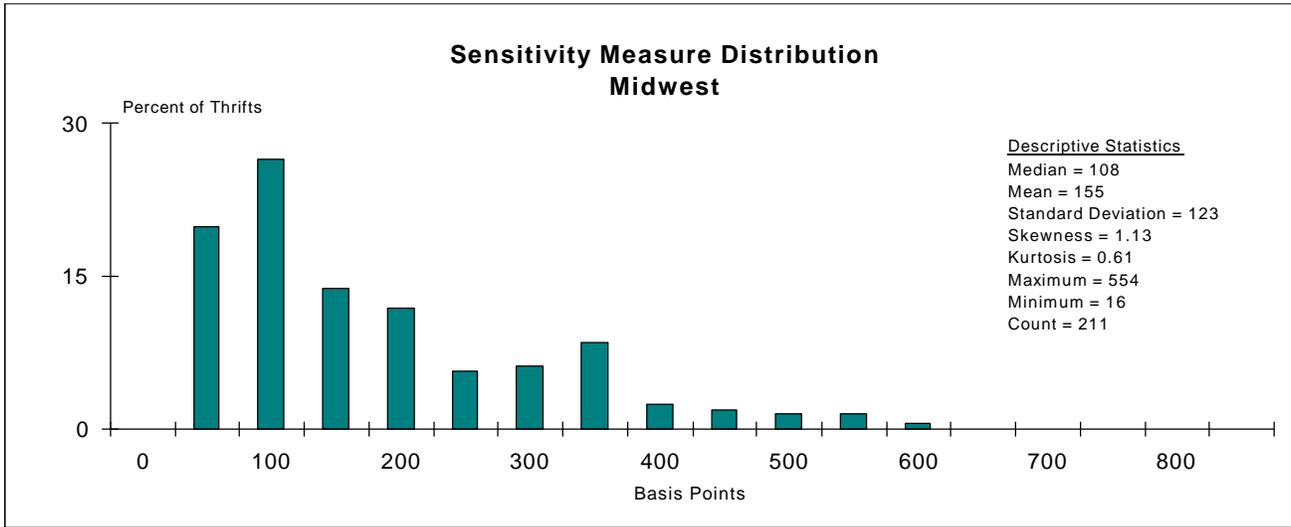
## Appendix B – Northeast Region



## Appendix C – Southeast Region



## Appendix D – Midwest Region



## Appendix E – West Region

