

## Estimating Deposit Rate Sensitivity: Retail Certificates of Deposit

Most asset/liability (A/L) practitioners would agree that one of their primary functions is the simulation of net interest income in various rate scenarios. Estimating the relationship of deposit rates to changes in market rates (e.g., Treasuries, LIBOR, Fed Funds) is among the more problematic components of this task. This article reviews a straightforward method of estimating the rate sensitivity of retail certificates of deposit (CDs).

**Introduction.** Recently, Fischer Black, writing in the Financial Analysts Journal, pointed out that a primary objective of financial analysis was to "... come up with the theory first, then evaluate the data." Also recently, some voluminous, technical, econometric-based papers have been presented that attempt to quantitatively describe the process of deposit rate setting. Complex, stepwise, multi-factor regression deposit sensitivity studies have also been generated that appeal to abstruse bank regulators, but are non-intuitive to bank management. Thus, there is a disconnect between the data mining practitioners and management who set deposit rates in bank asset/liability management committee (ALCO) meetings. It is therefore appropriate to review the issues involved in de-posit pricing decisions (e.g., typical ALCO actions), prior to considering simulation factors and developing regression parameters.

**Deposit Pricing Considerations.** The overall objective of ALCO pricing decisions is to maximize long-term profitability; practically, this usually translates into consideration of the issues shown in Exhibit 1 on page 2 (an illustrative, not exhaustive list).

The ability of ALCO support staff to present decision alternatives in a meaningful format is more important to ALCO management than mere technical prowess. Many of the leading A/L simulation models

have the capability to facilitate the analytical process by relating products such as Retail CDs to an index rate(s), with varying spreads, sensitivities, and time lags, as well as analogous balance sheet features. The following sections suggest two straightforward regression methods to assist in completing the decision support process via assessment of the relationship of CD rates to changes in market rates.

**Regression Model Design.** The deposit sensitivity was estimated via a regression analysis between Treasury rates and deposit rates using monthly data for the past five years. This example focuses on the one-year sector for CDs, as they frequently are the largest balance CD category. The correlations suggest that the best fit occurred when CD rate changes lagged Treasury bill changes by three months, unless otherwise noted. This approach is also consistent with the simulation modeling practices from several regional East Coast banks. The first three ALCO issues are considered in the single and two factor models below:

1. *Competition pricing* - The Bloomberg database uses Banxquote rates on a monthly basis for each state.
2. *Market share* - Specifically, the individual and average rates of the three largest banks in each state are reported.
3. *Changes in rates* - regression coefficients suggest a partial sensitivity (or beta < 1.0) between one-year CD and Treasury bill yields.

(See End Note on data sources for additional comments.)

**Single Factor Model.** This single factor model uses the general form of  $Y = A + BX$ , where:

1. Y is the estimated one-year CD rate;
2. A is the intercept (sometimes viewed as the floor with a zero market rate);
3. B is the estimated sensitivity (or beta) to the one-year T Bill yield, lagged three months; and
4. X is the one-year T-Bill yield, lagged three months.

Examples of this procedure in A/L modeling and

### EXHIBIT 1. DEPOSIT PRICING CONSIDERATIONS

Issue	ALCO Action	Simulation Factors	Regression Parameters
Competition pricing	Review competitors rates	Lead or lag rate changes?	Banxquote monthly rates
Market share	Leaders vs. followers	Higher or lower spreads?	3 largest banks per state
Changes in rates	Actual & prospective	Partial or full sensitivity?	Sensitivity & spreads
Profitability	Budget vs. actual	Spreads & balance sheet mix	N/A
Alternative funding	Retail vs. wholesale	Spreads & balance sheet mix	N/A

**EXHIBIT 2. SINGLE FACTOR MODEL**

Single Factor Model						
	Intercept (A)	Treasury Slope/B	Correlation	R <sup>2</sup>	T-Test	
National	1.97	0.62	0.62	0.38	5.90	
FL	0.25	0.79	0.82	0.67	10.90	
PA	0.56	0.68	0.83	0.69	11.20	
NJ	3.20	0.22	0.70	0.49	7.40	
NY	1.51	0.59	0.83	0.69	11.20	
MA	1.00	0.72	0.73	0.53	8.00	

ALCO pricing include:

- 9.00% = .50% + 1.0\*8.50%- Prime + .50 lending
- 5.20% = .00% + 0.8\*6.50% - 10 year municipal rate = 80% of 10 year Treasury rate
- 5.50% = -.50% + 1.0\*6.00% - one-year CD spread to one-year T Bill pricing

This simplistic rate beta model suggests that, on average, over the past five years, the national average one-year CD rate was equal to 1.97% + .62 \* prior quarter one-year T Bill rate, with a correlation of 62% and R<sup>2</sup> of 38%. It further suggests that the rate beta varies by state and we would further suggest that it varies by region and institution. (See Exhibit 2.)

**Two Factor Model.** This two factor model uses the general form of  $Y = A + B_1X_1 + B_2X_2$ , where:

- Y is the estimated one-year CD rate;
- A is the intercept;
- B<sub>1</sub> is the estimated sensitivity (or beta) to the change in the one-year T Bill yield over the past three months;
- X<sub>1</sub> is the change in the one-year T Bill yield over the past three months;
- B<sub>2</sub> is the estimated sensitivity (or beta) to the prior quarter's one-year CD rate; and
- X<sub>2</sub> is the prior quarter's one-year CD rate.

In this example, the sensitivity to changes of the one-year T-Bill yield is estimated directly. For institution-specific analyses, we further refine this process by segregating the data into regimes of increasing versus decreasing rates to generate dual rate betas. Again, both of these approaches are consistent with the simulation modeling practices from several

regional East Coast banks.

This two factor rate beta model suggests that, on average, over the past five years, the national average one-year CD rate was equal to 2.88% + .73 \* change in the one-year T Bill rate + .39 \* prior CD rate, with a correlation of 92% and R<sup>2</sup> of 85%. It further suggests that the rate beta varies by state and is directionally consistent with the single factor model. (See Exhibit 3.)

**Conclusion - The 80/20 Rule Applies.** An Italian economist formulated a general relationship between a production and output during the 19th century. Vilfredo Pareto wrote "In any series of elements to be controlled, a selected small fraction in terms of number of elements almost always accounts for a large fraction in terms of effect." Today we know it as Pareto's Principal, or the 80/20 rule. Pareto's postulate says that 20% of your effort will generate 80% of your results. There is also a corollary: 20% of your results absorb 80% of your resources or efforts.

The world of finance, including bank A/L management, is rife with applications of Pareto's postulate. Perhaps a sensible A/L cost/benefit-based 80/20 rule should be: When the R<sup>2</sup> approaches 80%, it's time to move on, because the next 20% of your results will absorb 80% of your resources or efforts.

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Note on Data Sources. The source of the data is Bloomberg Financial unless otherwise noted. Treasury

**EXHIBIT 3. TWO FACTOR MODEL**

2 Factor Model						
	Intercept (A)	Change in Treasury Slope/B <sub>1</sub>	Prior Quarter CD rate Slope/B <sub>2</sub>	Correlation	R <sup>2</sup>	F-Test
National	2.88	0.73	0.39	0.92	0.85	146.00
FL	0.96	0.82	0.77	0.85	0.72	67.60
PA	0.99	0.50	0.75	0.72	0.52	27.60
NJ	0.79	0.25	0.82	0.80	0.64	45.10
NY	0.88	0.72	0.81	0.80	0.64	44.10
MA	0.82	0.63	0.82	0.83	0.69	56.30

rates are per the Bloomberg database, with CD rates contributed by Banxquote. Approximately 5 years (3/95-12/99) of data was used (the limits of Banxquote's database on Bloomberg). Regression results reported herein use Bloomberg's "Multiple Recession Creation" function. The following basic recession assumptions were met:

1. Linear relationship between the dependent and independent variables.
2. Dependent variables were interval scaled.
3. Residual variation appeared to be normally distributed (homoscedastic)
4. Autocorrelation was not apparent in excess of "normal" financial time series data. Note that the use of time series data in financial modeling and forecasting is subject to a number of additional caveats.

As a reminder,  $R^2$  is the coefficient of determination, usually described as the proportion of the dependent variable that is explained or accounted for by the variation in the independent variable(s). Reported regression equations are significant at the 95% significance level unless otherwise noted. A one-month lag for the national two-factor model is displayed above.