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A Primer on Core Deposit Duration (Part 3)

A simplified framework for understanding the sensitivity of duration estimates to assumptions, and assessing their reasonableness, will ease the complicated issues facing the asset/liability management (ALM) professional. This guide will assist in the estimation and reporting of duration of various core deposit products, many of which are numerous and complicated. This three-part series of articles contains three sections. Part 1 discussed Section I, the textbook definition of effective duration applicable to core deposits (see *BALM* June 2006, p. 7). Part 2 (see *BALM* August 2006, p. 3) discussed a simplified rate model to capture several key aspects of bank pricing behavior. One of the four standard rate parameters was shown to dominate the others.

This final part in this series of articles will discuss Section III, balance sensitivity assumptions and core deposit duration.

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Section III – Balance Sensitivity Assumptions and Core Deposit Duration. In the prior section, we demonstrated that duration effects of the interaction between balance maturity and rate assumptions depend upon how the rate is modeled. Even a simple balance sensitivity model can significantly complicate the calculation of duration. The balance sensitivity model displayed in Exhibit 1 on page 2 has four parameters that determine its location in the two-dimensional space defined in the exhibit. These are:

- Maximum monthly balance growth rate (*maxgrowth*)
- Zero growth spread (ZGS)
- Balance sensitivity to *spread (a.k.a. the slope of the line in Exhibit 1)(elasticity)*
- Maximum monthly balance outflow rate (*maxoutflow*).

The equation governing the figure is

(6) MAX{MIN[elasticity(product spread – ZGS), maxgrowth],maxoutflow}

Equation (6) captures key characteristics incorporated into models of deposit balances: When deposit rates are near, or above, market rates (for example, banks raising deposits on the Internet frequently pay above LIBOR), bank balances tend to increase. When deposit rates are significantly below market rates, balances tend to decline or grow below trend. Trend factors can be added to the model, by placing a constant term in front of equation (6). (Equations 1 through 5 are shown in Parts 1 and 2 of this article series.)

An Example (see Exhibit 2). Suppose we set the following parameters for the above model:

- Maxgrowth = 1%
- Maxoutflow = - 1%

EXHIBIT 1. STYLIZED MODEL OF BALANCE SENSITIVITY

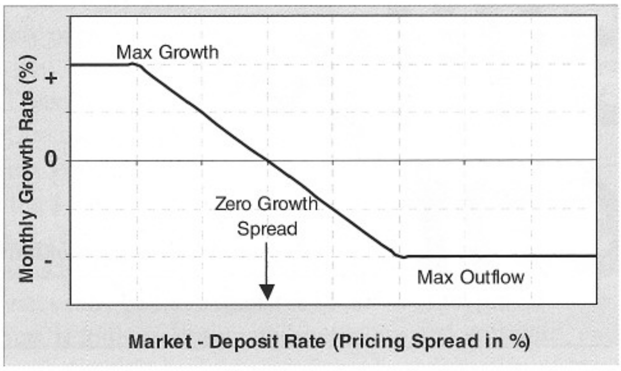
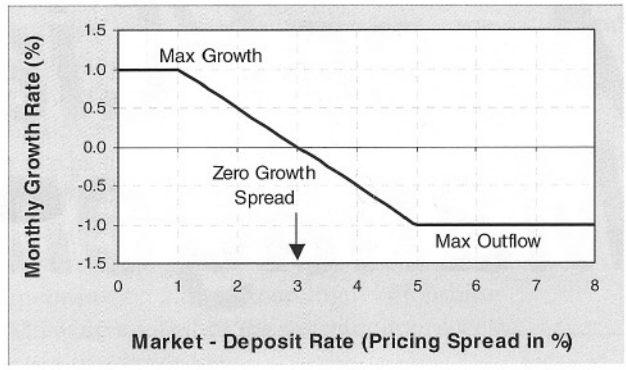


EXHIBIT 2. EXAMPLE OF STYLIZED BALANCE MODEL



- ZGS = 3%
- Elasticity = -.5

Based on these parameters, balances grow when the pricing spread is less than 3 percent and decline when spreads are wider than 3 percent. There is some sensitivity modeled so that even wider spreads lead to some balance outflows capped at 1 percent per month. Narrower spreads lead to balance growth and these too are capped at 1 percent per month.

Estimating balance sensitivity parameters from bank data often is very difficult, and we make no claim that equation (6) is a perfect representation of balance behavior. The purpose of the model is conceptual: to capture the major components of how balances might react and to study how these behaviors impact core deposit duration estimates. As we show next, even with this simple model, incorporating rate sensitive balances into a model of core deposit duration complicates the model significantly. We show that the results are dependent upon how much balance sensitivity is built into the model and whether balance growth is allowed.

Under What Circumstances Should Balance Growth be Incorporated into a Duration Model? This question plagues the estimation of core deposit duration, as well as other measures of interest rate risk. The answer depends entirely on the purpose of the calculation. Exhibit 3 on page 3 categorizes some of the issues relevant to the question.

As indicated in Exhibit 3, a significant range of approaches exists for modeling core deposit balances. Regulators typically prefer more conservative assumptions, particularly when applied to liquidity analyses. By contrast, risk managers may be interested in more liberal assumptions. However, if the purpose is to measure economic value sensitivity, the right answer is to make explicit decisions about what is to be included in a measure of *equity at risk*.

If the bank hedges the exposures of its economic equity (including the core deposit intangible) to changes in interest rates, then some measure of trend balance growth may need to be included in the measure. Alternatively, if bank management only wants to hedge existing balances, it may need to employ more conservative assumptions in its deposit balance models. In either case, these assumptions can be nested in the model described in Exhibit 1.

Next we consider two pricing examples and how the *balance* modeling assumptions may impact duration. In this case, we need to consider both *balance sensitivity to interest rates* and *maturity*. We use two maturity profiles to demonstrate the effects.

- Product 1: Fixed-rate deposit paying 1.5 percent
- Product 2: *Sticky* floating rate deposit with a proportionality factor of .75 and pricing lags of 0.25

In Exhibit 4, the impact of variations in the rate of balance growth on effective duration is reported. As indicated, alternative balance growth assumptions impact the value in a way consistent with the view that growing balances extend duration and declining balances shorten duration. The impact varies with the *stickiness* of the rate.

Including Balance Sensitivities in Models of Core Deposit Duration. Incorporating rate sensitive balance growth assumption complicates the interpretation of the results, which are responsive to both the balance sensitivity parameters and the rate scenarios used to calculate duration. When rate sensitive balance models are excluded, the rate scenario used to calculate duration has little impact. This is because the second rate scenario used in the calculation is a shock of the first. Including balance sensitivities can change this result because, in one rate scenario, balances may grow; in the second, balances may decline, depending on exactly how the balance sensitivity parameters are set. In other words, relatively minor

EXHIBIT 3. ALTERNATIVE APPROACHES TO MODELING CORE DEPOSIT BALANCES

<table>
<tr><th colspan="4">Assumptions About:</th><th>Comment</th></tr>
<tr><th colspan="2">Existing Customers</th><th colspan="2">New Customers</th><td rowspan="2">Most conservative: balances decline rapidly with balance outflows and account closures*</td></tr>
<tr><th>Account</th><th>Balances</th><th>Account</th><th>Balances</th></tr>
<tr><td rowspan="3">Account closings explicitly modeled</td><td rowspan="2">No balance additions</td><td colspan="2" rowspan="2">None</td><td>Frequently an approach requested by regulators</td></tr>
<tr></tr>
<tr><td>Balance additions modeled</td><td colspan="2">Included, but limited</td><td>Balance growth possible as average balances per account grow, but overall growth is limited</td></tr>
<tr><td colspan="4">Balances modeled in the aggregate allowing for trend growth in total balances</td><td>Most aggressive: can change duration estimates by a sign</td></tr>
<tr><td colspan="5">* The most extreme version is not to allow within-month balance additions. When monthly average or month-end balances are used for the analysis, this issue is ignored.</td></tr>
</table>

EXHIBIT 4. IMPACT OF BALANCE GROWTH AND OUTFLOW ASSUMPTIONS ON DURATION

		Product	
Maturity	**Balance Assumptions**	**Fixed Rate**	***Sticky* Rate**
5 Yrs	6% per year outflow	-4.0	-1.1
	3% per year outflow	-4.3	-1.1
	No change	-4.7	-1.2
	3% per year growth	-5.1	-1.3
	6% per year growth	-5.5	-1.3
10 Yrs	6% per year outflow	-6.3	-1.4
	3% per year outflow	-7.3	-1.5
	No change	-8.7	-1.7
	3% per year growth	-10.4	-1.9
	6% per year growth	-12.9	-2.2

changes in the rate scenarios used to project deposit rates can impact the average pricing spread projected in the two scenarios, which in turn influences the simulation of balance growth used to calculate duration. Relatively minor changes can have large effects, as shown in Exhibit 4.

This is a key finding for modelers of core deposit duration: Including rate sensitive balances in the duration model can lead to duration estimates for core deposits that are sensitive to the forward rates. While senior management is familiar with convexity and its effects on the duration of defined maturity products, experience indicates that they have less comfort with monthly changes in duration estimates for such products as savings and interest checking accounts.

We have observed some modelers ascribing that changes in duration estimates incorrectly to balance sensitivity parameters are not known with precision, when we have shown that this arises because duration estimates are sensitive to the interplay of simulated pricing spreads and the resulting balance growth. When the uncertainties associated with balance sensitivities are added into this mix, results may be sufficiently unreliable that we recommend that modelers avoid point estimates and instead produce only range estimates for core deposit durations.

Conclusions and Implications to Calculating the Duration of Equity. The intent of this primer series is to help clarify the effect of different modeling approaches on estimates of core deposit durations. It should be especially useful for modelers whose goal is the satisfaction of regulators, whose attention is often focused on the modelers' understanding and documentation of the effects of modeling assumptions on the resulting core deposit duration estimates.

For institutions with material core deposit balances and who use a value-based interest rate risk measure to manage balance sheet risk, this primer should raise a timely warning flag. We have shown that durations for some deposit products can be estimated only within a range of values because of uncertainties associated with balance responses to interest rates. Asset/liability (A/L) managers and their A/L management committees (ALCOs) should recognize the resulting uncertainty regarding the estimated duration of equity and factor it into the evaluation of both risk limits and balance sheet hedge design. Risk measurement and risk limit processes relying on these measures should incorporate this uncertainty into their decision making.

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Interest Rate Swaps

As derivatives have grown in popularity over the past decade in the private sector, it makes sense that governments have found derivatives useful as well. Recently, the Governmental Accounting Standards Board (GASB) has proposed that "the fair value of derivatives be reported as assets or liabilities in the financial statements (depending upon whether they represent resources or claims on resources, respectively)." This change, if approved, will expose derivatives to readers of financial statements, so governments that currently use or plan to use these instruments should become well-founded in the basics of derivative instruments. This article discusses interest rate swaps.

This two-part series will discuss the benefits of derivatives, and focus on swaps—their transaction structure and terms, typical swap transactions, alternatives to plain vanillas, participants, market structure—primary and secondary markets and swap documentation. The series will conclude with a brief discussion of the potential problems of swaps.

Benefits of Derivatives. Both Standard and Poor's and Moody's (Standard and Poor's Rating Group February 2002 and Moody's Investors Service October 2002) bond rating services view the prudent use of variable rate debt and interest rate swaps as part of a municipal bond issuer's risk management program. Interest rate swaps can be an effective tool in meeting funding needs and managing the balance sheet while limiting risk. Swaps also increase financial flexibility and reduce interest costs. The GFOA also believes that derivative products can be an important interest rate management tool (GFOA Recommended Practice, Use of Debt-Related Derivatives and the Development of a Derivative Policy (2003 and 2005)).

For instance, a swap product such as a synthetic floating rate swap with basis swap could be established with the goal to introduce a limited amount of floating rate exposure to lower debt interest costs. This derivative strategy would require the following action steps:

- Execute a fixed-to-floating interest rate swap, where the government receives fix interest and pays interest based on the Bond Market Association (BMA) Index;
- Arrange for a seven-year term to limit risk; and
- Add a basis swap to hedge the floating rate risk while producing incremental cash flow savings.

The expected result of this hedge would be to lower debt interest costs by a defined percentage.

Interest Rate Swap Definition. An interest rate swap is simply an agreement between two parties to exchange interest cash flows. It is a common misconception that the exchanged cash flows are always a fixed rate and a floating rate. However, fixed/floating swaps are typical but hardly the only type of swaps.

In a swap, one party agrees with a counterparty to exchange cash flows at periodic intervals. The parties exchange cash flows that are based upon different interest rate amounts for a given period, which is called the tenor. Of course, this does not work well unless both parties are paying interest on the same amount of principal. The amount of principal involved in a swap contract is called the *notional* amount. It is called the notional amount because no principal ever changes hands. Only interest amounts are exchanged between the parties. Swap market participants refer to *notional* principal because, unlike bonds or other conventional credit instruments, swaps do not involve an exchange of principal. Rather, the swap parties state the principal amount only as a basis for determining the sizes of the coupon payments. In this application, principal is only a reference point or idea, hence the term.

In fact, only the net amount of interest due to one of the two parties is exchanged. When rates are high, the floating-rate recipient gets the net difference between the interest due based on the floating-rate and the interest due to the counterparty based on the fixed-rate. When rates are low, the fixed-rate recipient receives the net difference from the counterparty.

Swap Transaction Structure and Terms. Most often, one cash flow derives from a fixed interest rate, the other from a floating interest rate, although both could be floating, and the market has developed innumerable variations on the theme. The most common example is where one party pays the counterparty a fixed rate of interest. At the same time, the counterparty pays a floating rate of interest to the first party. Thus, you might hear of someone agreeing to pay fixed and receive floating on $50 million notional for five years. That obligates the parties to 10 semi-annual cash flow exchanges. Only the net amount of interest due to one of the two parties is exchanged. When rates are high, the floating-rate recipient gets the net difference between the interest due based on the floating rate