

money to work or the lack thereof, ensure that you are prepared to fill any funding gaps and respond in accordance with your overall risk position. The response will vary from bank to bank. Review the strength of your access to the FHLB based on loans pledged as collateral. Establish, test and document the use of alternative funding sources like brokered and national market deposits. And revisit the appropriateness of your existing Board-established policy guidelines for limitations on each unique source of alternative funding. These policy limitations may be dated relative to how your risk profile has changed and the variety of funding sources that are readily utilized among your peers.

Credit and Capital Have Re-entered the Room!

The 2007/2008 great recession resulted in significant supervisory attention on credit concentration, capital sufficiency and underwriting standards. Roll the clock forward and new regulatory guidance was published as related to liquidity and interest rate risk, two significant components of asset and liability management. Interestingly, things are coming full circle in that understanding how future stressful economic events could impact credit losses and capital has increasingly become an important facet of enterprise risk management and capital planning.

Since the introduction of mandated credit stress testing at the largest banks (CCAR and DFAST), there has been a progressive migration toward the community banking space. Additionally, supervisory comments this year have been noting with increased frequency “the considerable growth in CRE in recent years, looser underwriting standards with less restrictive covenants, extended maturities, longer interest-only periods, limited guarantor requirements, and deficient stress-testing practices.” At the same time, a possibility that at some point over the next few years our economy will slow and reenter recession cannot be ruled out. This is a potential risk that can be quantified. As a result, a more formalized approach to credit stress testing is becoming a *best practice* activity as community banks of all sizes are recognizing the benefits of credit stress testing in the context of overall strategic planning, supporting ongoing loan growth and risk management. While this exercise can range in complexity, it should ultimately provide your key stakeholders with an easily understood picture of the strength and sufficiency of current capital relative to stressful and changing economic conditions.

It is impossible to exactly describe a future outcome and it is not profitable to remove all risk from a balance

sheet. However, one can remove uncertainty by looking at the risks that are brewing and quantifying their potential impact to determine whether they are manageable. Be certain to not only quantify the interest rate, liquidity and capital risks, but also ask and answer, “*Are these risks something we can live with? And for how long?*” ■

— Keri M. Crooks, Managing Director
Darling Consulting Group

A Review of Retail Deposit Pricing in the United States: Before and After the Financial Meltdown

The extended period of low and, effectively, floored bank deposit rates prevalent during and since the *Great Recession* has raised concerns about bank readiness to effectively manage the rate-setting process when monetary policy reverts to a more market-oriented focus and rates begin to rise.

In this article we examine and present evidence from actual rate histories as to whether deposit management has become less rigorous and systematic in the post-recession, low-rate world. To accomplish this we employ a rate model incorporating partial adjustment and asymmetrical responses to evaluate rates in national, regional and local markets.

We first examine the pre-recession period and document a robust and durable pattern of **deposit rate structures** incorporating consistent approaches to pricing, tiering, bounding and cross-product constraints. We then examine the recession and post-recession period for evidence of continuity of the rate structures and, by implication, the processes that determined them.

We conclude that, although monetary policy has driven all rates lower and forced a rate convergence among product tiers, the pre-existing structural relationships remain both evident and robust with both the core deposit and the CD product groups.

Market Rate Histories. We begin with an examination of deposit driver rates and present in Figure 1 a graph of the 16+ year rate histories for 1-month LIBOR, 12-month LIBOR and 5-year Swap rates. We selected 1-Month LIBOR because it is commonly used by bank liability pricing committees¹ to price core deposits. 12-month LIBOR and the 5-year Swap rates are most frequently applied to price 1-year and 5-year CDs, respectively.

Figure 1. Selected LIBOR and Swap Rates

Figure 1

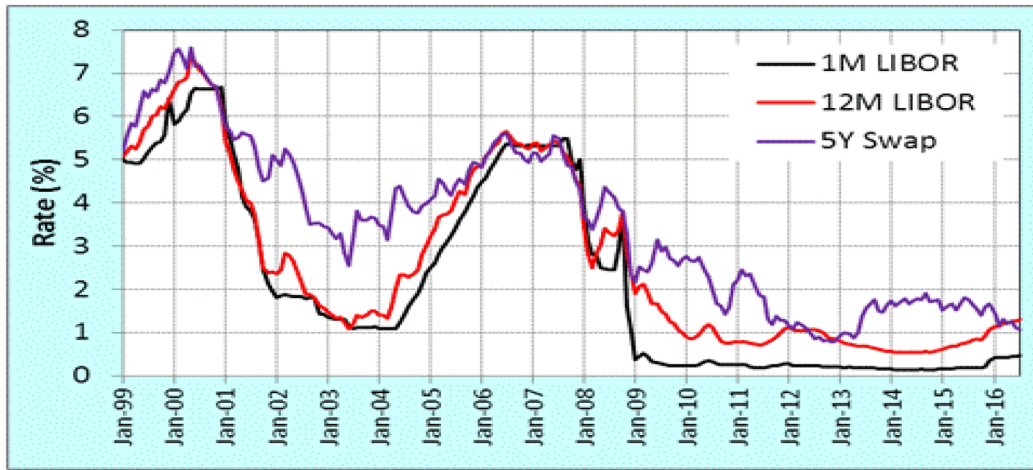


Table 1. Average Monthly Market Rates
Jan 2009 – Nov 2015

| Rate | Average |
|-----------|---------|
| 1M LIBOR | 0.23 |
| 3M LIBOR | 0.37 |
| 12M LIBOR | 0.91 |
| 3Y Swap | 1.12 |
| 5Y Swap | 1.76 |

The data depict two significant rate cycles prior to 2008, followed by a rapid secular decline induced by monetary policy beginning in late 2008, with only a single rise following a 25 basis point increase in the Fed Funds rate in December 2015.

In the post-recession period there was little reason for core deposit rates to reprice and, absent a policy of induced negative rates, no place for rates to go. Short term LIBOR and, consequently core deposit rates were remarkably stable. CD rates are tied to longer-duration driver rates that match the maturity yield of the products and market expectations of future rate increases. As a consequence, these rates were higher and showed greater volatility as indicated in Table 1, average yields on three LIBOR maturities and a 5 year Swap rate.

While these histories are well-known to the readers of BALM, our purpose is to demonstrate that, even with short-term rates approaching zero and the relatively flat yield curve, the data allow us to discriminate pricing behavior and confirm our finding of stable rate pricing structures across two broadly different rate environments.

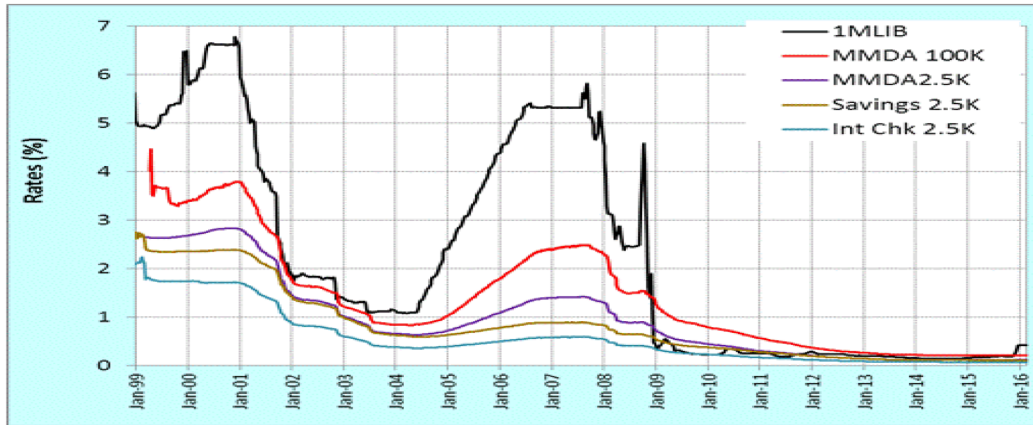
Retail³ Core Deposit and CD Rates before and After the Financial Collapse. We first examined rates for core deposits at the dominant⁴ \$2.5K tier. In Figure 2, following, we plot the rate histories for that tier of MMDA, Savings and Interest Checking products, along with MMDA in the \$100K tier, against 1-month LIBOR. In Table 2 we tabulate the average rates, by product. We observe a persistent structure of relationships among these rates including the following:

- On average, the savings rate is above the interest checking rate
- Lower balance money market rates are above the savings rates
- High tier money market rates are above the low tier money market rates

A close examination of the average rates, see Table 2, reveals that this pattern was compressed in the post-recession period, but maintained on average throughout the sixteen years.

Figure 2. Selected Retail Core Deposit Rates

Figure 2



Note: Data are weekly extracts from the ALCO Partners database.

Table 2. Average Retail Core Deposit Product Rates: January 2009 – November 2015

| Product | Pricing Tier | Average |
|-------------------|--------------|---------|
| Interest Checking | \$2.5K | 0.14 |
| Savings | \$2.5K | 0.22 |
| Money Market | \$2.5K | 0.25 |
| Money Market | \$100K | 0.44 |

Next, we examined CD rates for a representative \$10K pricing tier, plotting each maturity against its relative index. Results are shown in the four panels in Figure 3.

As was the case in core deposits, we observe a persistent structure of relationships, determined principally by maturity, among these rates. What’s more, these relationships were more readily discernible during the period

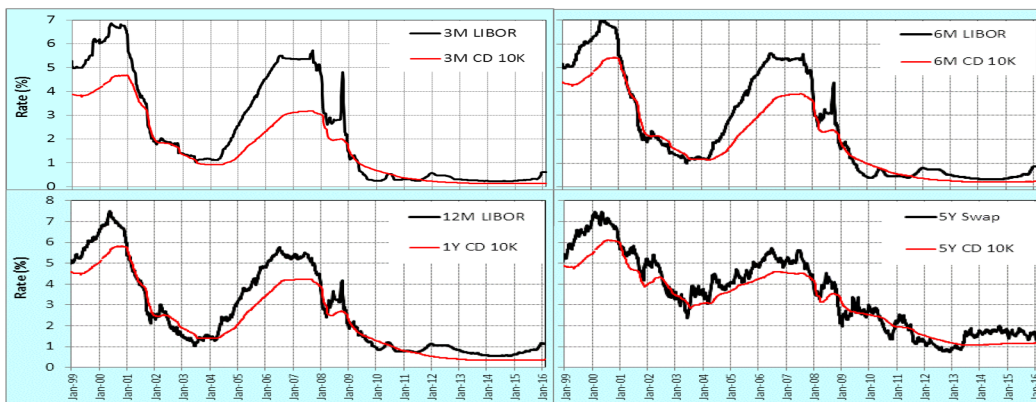
preceding the *Great Recession*, but nonetheless present and robust in the period since and, therefore, throughout the period we examined.

Preliminary Observations on Retail Deposit Pricing Histories. First, the relationships among the core deposit rates are robust over a very long historical period. As amplified above, tier pricing and cross-pricing constraints have persisted over the entire period and across all geographies. Second, the well-documented asymmetric pricing responses of deposit rates to market rates is confirmed. Increases in deposit rates lag market rates in an *up* market and are adjusted more quickly in a *down* market.

Finally, liability pricing committees respond to short-term volatility by *smoothing* the rate-settings on CD rates. This effect is most apparent in the pricing of 5-year CDs, as shown in Figure 3.

Figure 3. Selected CD Rates

Figure 3



Note: Data are weekly extracts from the ALCO Partners database.

Partial Adjustment Models and Their Application to Deposit Rates. Partial adjustment models are widely used in econometric estimation of time series data.⁵ They are frequently used to explain the evolution of a dependent variable that depends on an independent exogenous variable, in this case the market rate, in the long run, but adjusts to some equilibrium relation only with a lag; hence, the name *partial adjustment*.⁶

We employed the model below (Partial Response Deposit Rate Model), using weekly data from January 1999 to December 2015⁷ to describe all of the rates above and to illustrate our principle observations and conclusions regarding the presence and durability of rate structures of both core deposits and CDs. We then back-tested the estimation of deposit rates against the evolution of rates from September 2008 through December 2015. Table 3, below, summarizes our estimates and results.

Partial Response Deposit Rate Model

As an approximation, deposit rates can be simulated using a four factor "partial response" model, which is summarized by two equations:

Target Rate Equation: $DR^*(t) = S + P * MR(t), DR^*(t) \geq 0$

Actual Deposit Rate: $DR(t) = \text{MAX}\{DR(t-1) + \lambda(d) * [DR^*(t) - DR(t-1)]\}$

Where,

- MR(t) = the market interest rate in week t that motivates the change in the deposit rate which is assumed to be the 1 month Libor rate for core deposits and matched maturity for CDs.
- DR*(t) = theoretical "target" or equilibrium deposit rate in week t should market rates evolve to a specific level and remain there
- S = spread coefficient in the target rate equation
- P = proportionality coefficient in the target rate equation
- λ(d) = a adjustment speed coefficient that is allowed to vary depending on whether rates are rising or falling

Given a sufficient time series of product rates, the above equations can be estimated in EXCEL using the SOLVER.⁸

Table 3. Partial Adjustment Model Estimates

| Product | Variable | | | | R2 to Aug'08 | MAD* (Sep'08-Dec'15) |
|-------------------|----------|------|--------|---------|--------------|----------------------|
| | S | P | □(up) | □(down) | | |
| Interest Checking | -0.52 | 0.29 | 0.0016 | 0.0094 | 0.9978 | 0.04 |
| Savings | -0.72 | 0.42 | 0.0012 | 0.0088 | 0.9984 | 0.06 |
| MMDA 2.5K | -0.64 | 0.50 | 0.0052 | 0.0119 | 0.9998 | 0.08 |
| MMDA 100K | 0.10 | 0.51 | 0.0222 | 0.0466 | 0.9975 | 0.15 |
| 3M CD | -0.15 | 0.70 | 0.0235 | 0.0423 | 0.9997 | 0.15 |
| 6M CD | -0.04 | 0.79 | 0.0338 | 0.0517 | 0.9997 | 0.14 |
| 1Y CD | 0.08 | 0.81 | 0.0433 | 0.0586 | 0.9998 | 0.22 |
| 5Y CD | 0.22 | 0.82 | 0.0413 | 0.0568 | 0.9994 | 0.21 |

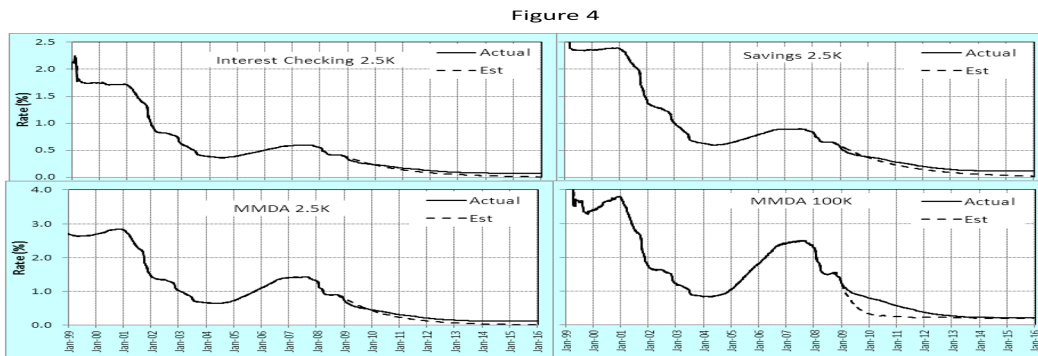
* MAD is the mean absolute deviation for the September 2008-December 2015 period, using the forecast lagged dependent variable in the out of sample simulation.

The high R² values reported in Table 3 are indicative of how well the model fit the data. Asymmetric pricing adjustments are also confirmed in the data, but their contribution to explaining, or reducing, the error is limited by the high correlations between current and lagged-dependent variables. We report them, nonetheless, because they capture the observed *asymmetric* behavior of liability pricing committees in responding more quickly to downward movements in market rates than to upward movements.

Our most interesting finding relates to the ex-post forecast performance summarized as *MAD* – the mean absolute deviation in the back-test. Our expectation was that error would be greater in the simulation period, principally because the equations were estimated using data with higher and more widely dispersed rates, as well as because the simulations did not incorporate any factor capturing cross-product constraints.

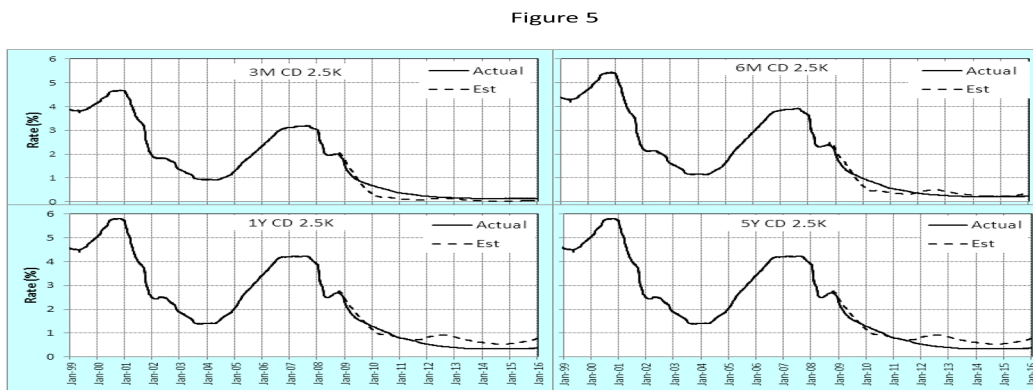
In Figures 4 and 5, below, we graph our estimations against actual results for core deposits, and CDs, respectively.

Figure 4. Simulated Retail Core Deposit Rates



Note: The estimated rates are so close to the actual rates between Jan '99 and Aug '08 that the differences aren't visible in these graphs.

Figure 5. Simulated CD Rates



Note: The estimated rates are so close to the actual rates between Jan '99 and Aug '08 that the differences aren't visible in these graphs.

Conclusions. Further tests indicate the importance of the zero bound constraint embedded in the target rate equation of the partial adjustment model used in this analysis. Absent that constraint, core deposit rates would become negative, a finding not true of CD rates. We also note that actual core deposit rates were consistently higher, by small margins, than simulated rates. The exception was the rates for the highest tier of money market accounts. In the two year period Feb 2009- Feb 2011 this deposit rate was 37 basis points higher than was predicted by the model. CD pricing generated a similar result, with the model simulating rates lower than actual. This effect dissipated for shorter term CDs and reversed for longer maturities.

Finally, we editorialize with a lament that data retention policies in many banks cause them to forego a growing list of potential benefits to be gleaned from their own data.

Notes

¹ We define core deposits as checking, interest checking, savings, and money market accounts.

² We use the Swap rates from the Fed's H15 report to provide the longer-term indicative market rates.

³ We focus on retail deposit rates as the commercial deposit rate histories show greater variance than the patterns discussed below.

⁴ We chose this tier because we had the most observations across the core deposit products. We chose the \$10K tier for CDs for a similar reason.

⁵ For example, Peter Kennedy, *A Guide to Econometrics* (2003)

⁶ For example, Hawkins, Ray and Arnold, Michael "Relaxation Processes in Administered Rate Pricing," *Physics Review E* (September 2000).

⁷ The models were estimated using data through August 2008 and simulated thereafter using a simulated lagged dependent variable for Sep '08 – Dec '15.

⁸ S and P were first estimated using the EXCEL "LINEST" function. ■

— Michael Arnold, Ph.D. & Bruce Campbell
ALCO Partners, LLC