

# Improving Usefulness of PPNR CCAR Stress Test Models: Adding 30+ Years of Rate Data to Deposit Balance Models

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*In expectation of eventual rising rates, PPNR modeling teams are searching for analytic insights on how deposit balances will behave when rates rise. But given the extremely low interest rates lasting most of a decade, many banks lack sufficiently long internal monthly history on their own deposit balances and rates at the necessary level of granularity to build PPNR models beyond a single rate cycle. To address this data shortcoming, Novantas uses as a rate proxy the time deposit share of total interest-bearing deposit balances ("CD-Share") as an independent industry variable in many deposit balance models. We develop forecasts of CD-Share using multi-decade industry history, adding decades of important rate sensitivity to deposit models that otherwise can only be trained on the ultra-low interest rates of the late-2000s to present. In this Perspective, we define CD-Share, explore how to build forecasts for this measure, and describe how CD-Share can improve deposit balance modeling performance.*

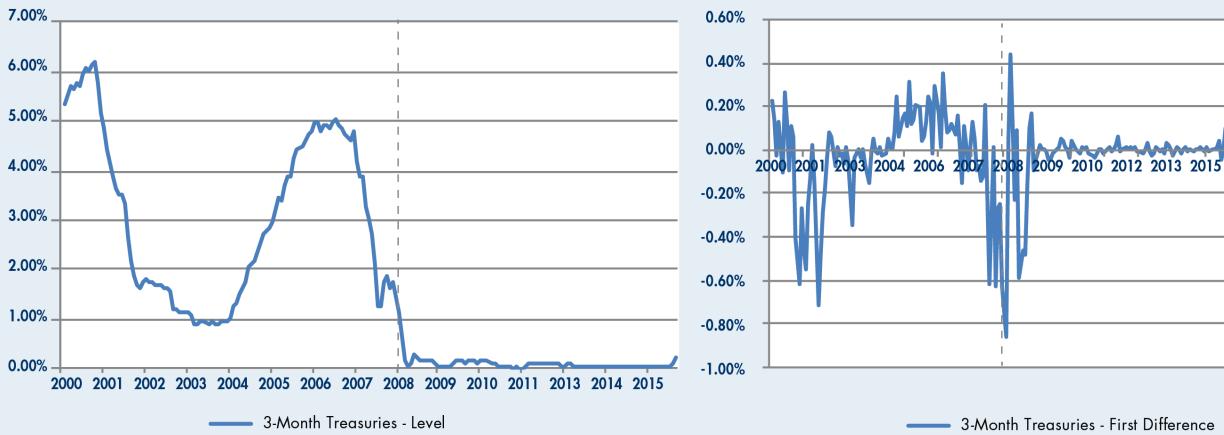
Clearly, market (or "wholesale") interest rates have a significant influence on deposit balances. The influence is greater for some products than others, but wholesale rates affect all deposit balances to some degree. As a result, incorporating responsiveness to wholesale rates is a requirement of a valid PPNR time series deposit balance model.

However, banks struggle to source sufficient internal history for their own deposits to prove this relationship analytically. Most have detailed monthly internal deposit data dating back to 2007, which allows them to represent the 2009 rate crash; but many fewer can fully capture the 2004–2006 period of rising rates. This creates a quandary over how best to model the influence of wholesale rates when the vast majority of the available time series reflects extremely limited rate volatility. The obvious solution of collecting better data going forward makes sense (and most CCAR banks we have talked to have such efforts underway), but many banks need to find a nearer term approach for capturing the influence of wholesale rates.

The challenge of reflecting interest rate dynamics in PPNR models is compounded by the very common approach of using "first difference" transformations (where the predicted value is the change in balance and most or all of the predicting values are also transformed to changes). Since 2007, there have been a very small number of months where rates have exhibited material

movements. An appropriately rate-sensitive PPNR balance model cannot be built on 2007—Present data when more than 80% of the data points exhibit no interest rate volatility. Figure 1 below demonstrates this data problem with the three-month Treasury rate.

**Figure 1: 3-Month Treasury Level and Monthly Change, 2000-2015**



The Novantas solution is to incorporate an industry measure with a much longer history as an independent variable. For any variable to serve as a good representation for historical wholesale market rate patterns, it would need to: a) correlate well with wholesale rate movements; and b) be conceptually appropriate for use in bank stress testing — i.e., that there is defensible business justification for using the chosen measure with the portfolios being modeled. One variable that meets both of these objectives is the **time deposit share of industry interest-bearing deposit balances**, which we label “**CD-Share**.<sup>1</sup>” We have found that the CD-share of interest-bearing deposits is highly correlated with Treasury rates, which makes it a useful single proxy for periods of higher versus lower rates.<sup>2</sup> And importantly, the industry data to calculate this measure is available back to the early eighties, so that a model built on this longer time series covers multiple rate cycles under different economic regimes.<sup>3</sup>

Using the CD-Share measure in deposit models allows banks to model their own balances directly as the dependent variable (DV), while achieving the objective of having the model trained (at least partially) on multiple rate cycles. The biggest cost of this technique is that one additional — but relatively straightforward — model must be developed.

The remainder of this Perspective discusses the details of why CD-Share is relevant and when, where, and how this measure should be used. We conclude with some implementation complications to avoid.

### CD-SHARE IS STRONGLY RELATED TO INTEREST RATE MOVEMENTS

We calculate CD-Share as total time deposits divided by total interest-bearing deposits, using the FDIC quarterly (monthly is not available) banking profile balance sheet:<sup>4</sup>

$$CD\text{-}Share_t = \frac{Time\ Deposits_t}{Total\ IB\ Deposits_t}$$

<sup>1</sup> An alternative measure would be CD share of all deposits, not just interestbearing; however, we believe customers make choices on where they keep interestbearing balances exclusive of their payment accounts.

<sup>2</sup> Using a single measure to reflect interest rate dynamics in balance models both simplifies the analysis of how wholesale rate movements influence the balance sheet, and provides direct quantification of balance flows due to changes in the wholesale rate environment.

<sup>3</sup> An alternative approach, which we reject, is for a bank to develop a model and forecasts for its own Bank-CD-Share. The risk with doing this becomes the confounding effect of trying to use the bank’s own CD share to predict the future of its CD and NMD balances, which recursively influences CD share. The algebra is beyond the scope of this Perspective, but the end result is a set of models with lagged dependent variables, which are typically macroeconomically insensitive and thus unacceptable in stress testing contexts.

<sup>4</sup> While there are other sources for deposit balances, we have found the FDIC data has been the best fit-for-purpose source for constructing CD-Share.

The relative attractiveness of CDs compared to liquid savings products such as MMDAs has historically been very closely related to interest rate movements, as shown in Figure 2. Depositors tend to hold greater proportions of their balances in term products when one-year Treasury rates are relatively higher, and shift their savings to liquid MMDA and savings products in lower-rate environments.

Importantly, the relationship is not immediate: there is a lag between wholesale rate movements and change in the CD-Share, which reflects both the contractual nature of CDs and the lagged response of customers — especially retail customers — to wholesale rate changes.

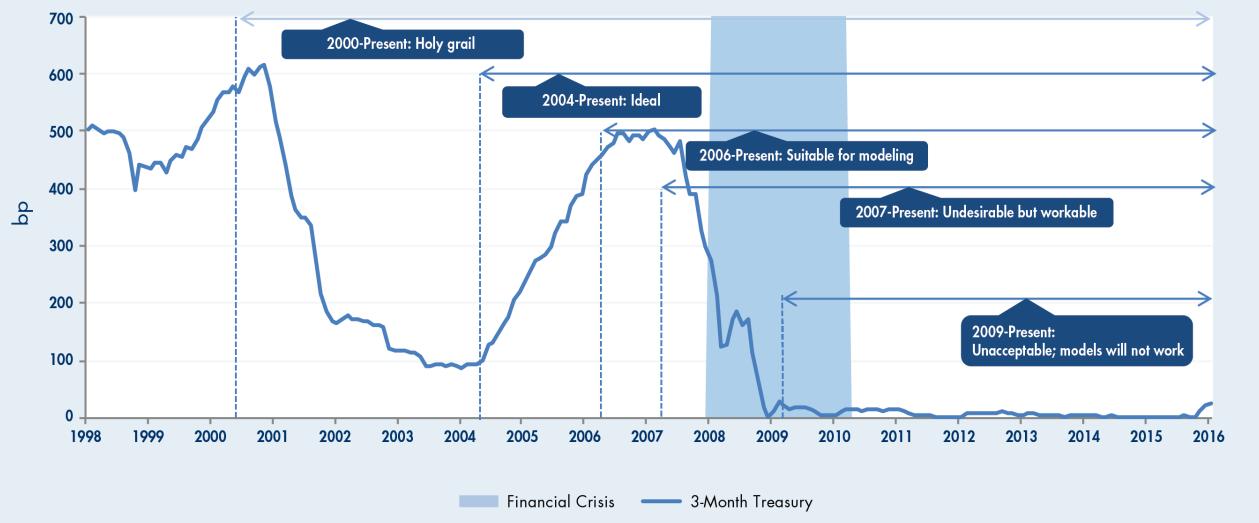
### CD-SHARE IS AN EXCELLENT PREDICTOR OF RATE-DRIVEN BEHAVIORS

One of the most difficult problems facing PPNR model developers is a lack of proper data coverage. As shown in Figure 3, the starting date of model data strongly influences the appropriateness of data for deposit product models where wholesale rates are a major driver of balances.

**Figure 2: 12-Month Treasury and CD-Share Over Time**



**Figure 3: 3-Month Treasury Rate and Availability of Modeling Data**



Almost all CCAR banks have robust monthly datasets back to 2007, but many lack pre-2007 balance and rate data at a level of granularity necessary for stress test modeling. This materially limits the ability to include wholesale rates directly in deposit models: wholesale rates have been effectively flat for 90 of the last 100 months, which means that the change in rate — necessary in a first difference model — is effectively zero in 90% of the observations.

CD-Share, by comparison, exhibits interesting — and understandable — characteristics coming out of the crisis. In 2007–2009 consumers aggressively locked in high-rate CDs and then subsequently migrated balances into liquid products as those CDs matured from late 2009 to the present.

The most immediate application of CD-Share is in reflecting the switching behavior of consumers between CD and MMA (see top panel of Figure 4). CD-Share is a positive correlate of a bank's CD balances and a negative correlate of a bank's MMA balances. This is useful because:

1. Most banks witnessed aggressive MMA growth during the 2008-2009 crisis, and having a quantified explanation ("our statistical model showed that XX% of our 2008-2010 MMA growth was due to CD switches") describes why.<sup>5</sup>
2. It is a major driver in understanding and explaining how MMA and CD balances will respond under various forecasts of Treasury rates (including out-of-sample scenarios like our latest negative interest rate scenario).

Further, bank-level CD share, derived from MMA and CD balances (the data on the top panel), can be well-approximated by an industry-level CD-Share (see bottom panel of Figure 4).

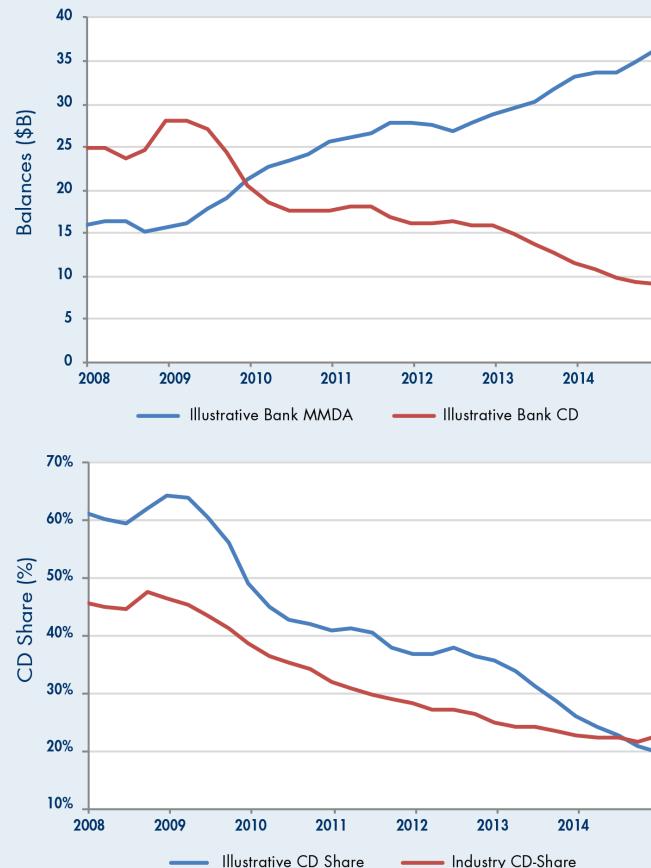
Since CD-Share is also an effective proxy for the rate environment, we have found other relationships in PPNR deposit modeling where CD-Share was a key driver:

1. Capturing the attractiveness of consumer interest-bearing DDAs, especially those offered with atypically competitive rates;
2. Identifying preferences between commercial interest-bearing, analyzed, and non-analyzed NIB DDAs; and
3. Understanding the relationship between operational and non-operational deposits held by large and small businesses and municipalities.

## HOW TO USE CD-SHARE IN PPNR STRESS TEST FORECASTING

One concern with using CD-Share as a predictor in PPNR models is that the Fed does not provide scenario forecasts for it. Since having forecasts under various macroeconomic scenarios is an absolute requirement for the use of a driver in PPNR Stress Test models, banks must build their own models to generate forecasts of any non-Fed-supplied macroeconomic variables. Figure 5 shows some of the 2016 scenario forecasts generated by such a model, including a base scenario which has been augmented with a 300 basis point upward rate shock in the first quarter of the forecast.

**Figure 4: MMA Balances vs. CD Balances for an Illustrative Bank**

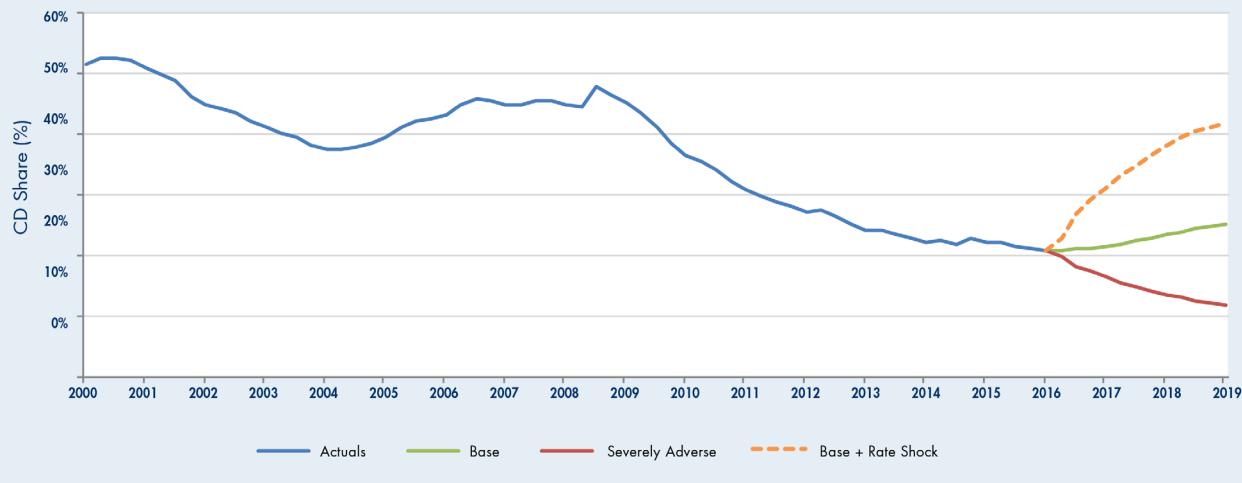


Source: Novantas

<sup>5</sup> Very few if any banks have the reliable account and customer-level information necessary to directly calculate this switching behavior over a data history suitable for stress testing. Even when the information is available, the number of necessary assumptions for the analysis threatens the applicability of a statistical model developed on the outcome for stress testing.

Building this additional CD-Share model turns a perceived limitation into an advantage: since there are more than four decades of industry balance data, a CD-Share model can be trained on the entire timeframe. Thus, when a Bank-specific model is built with CD-Share as a driver, any forecast is also partially informed by more than thirty years of wholesale rate behavior and resultant industry deposit balances.

**Figure 5: CD-Share Scenario Forecasts (2016 Base, Severely Adverse, and Base +300 bp Rate Shock)**



Source: Novantas

## NUANCES AND WATCH-OUTS

We have seen great success with the conceptual framework of using industry CD-Share as a proxy for whether Treasury rates are in a “high rate” or a “low rate” environment, but there are a number of nuances and challenges we have run into in implementation, including:

1. FDIC data on time deposits includes brokered CDs, retail CDs, and products held by non-consumer clients. Ensure you have the right assumptions and analyses to prove the industry measures are appropriate for use.
2. Building a CD-Share model and using CD-Share as an independent variable requires a strong conceptual framework of the respective roles of rate, non-rate macroeconomic, and strategic drivers in each of the respective models.
3. Proving similarity is important: the individual deposit balance trends of nearly all banks track closely enough to industry CD-Share, but analytically justifying and documenting that similarity is an often-overlooked step.
4. Modeling any percentage from 0–100% requires the use of specific dependent variable transformations, which can seem unintuitive without a bit of research.

**ABOUT NOVANTAS** Novantas is the industry leader in analytic advisory and solution services for financial institutions. Our Global Treasury & Risk unit partners with banks to advance their analytic capabilities — bringing to bear our thought leadership, advanced modeling techniques, and extensive experience. The Novantas PPNR Modeling and Forecasting team has worked with more than a third of CCAR banks on PPNR modeling engagements, and is routinely in contact with almost all CCAR banks, many DFAST banks, major international banks in 10+ countries, and U.S. and international regulators.

**CONTACT US** We welcome your feedback and are happy to continue the conversation about this article or other Treasury and Risk viewpoints. Please reach out to the head of Novantas Global Treasury and Risk, Pete Gilchrist at [pgilchrist@novantas.com](mailto:pgilchrist@novantas.com); or the head of Novantas PPNR Modeling and Forecasting, Jonathan “Wes” West at [jwest@novantas.com](mailto:jwest@novantas.com).