PERSPECTIVES

Beyond Duration in Cash Balance Liabilities

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In a 2022 Perspectives article, we analyzed some of the more nuanced ways rapidly increasing Treasury rates impacted pension plans, including increased interest crediting rates (ICRs) for cash balance (CB) liabilities. This article builds on those concepts.

Rates have moved such that the crediting formulas embedded in many cash balance liabilities now matter as much as the discount rate. Curve volatility is also more meaningful than it was in 2022 because Treasury yields are higher and many plans are now above their ICR floors. As a result, changes in the shape of the curve flow directly into projected benefits.

Three features determine how a CB liability responds to Treasury yields: the ICR basis, any modifications (such as floors or caps), and changes in the shape of the yield curve. Each is easy to overlook in a standard duration-based hedge and can leave a plan with funded status volatility that its liability-driven investing (LDI) program was not designed to address. We walk through each feature and then outline the practical implications for hedging.

Cash Balance Plans Respond Differently to Interest Rates

Traditional cash balance pension plans provide participants with a benefit expressed as a notional account, which grows over time based on a prescribed ICR. Each year, the account typically receives a pay credit (often a percentage of pay) and an interest credit equal to the account balance multiplied by the ICR. Generally speaking, participants may take the balance as a lump sum or convert it to an annuity.[1] For example, a hypothetical $100,000 balance earns $4,000 if the ICR is 4% and $5,000 if the ICR is 5%.

The ICR is typically based on a U.S. Treasury bond yield. For example, a plan may credit balances each year based on the 30-year Treasury yield. Valuing the liability, therefore, requires two rate-related inputs: an assumed path for future ICRs, which drives projected benefit payments, and a discount curve, which is generally based on high-quality corporate bond yields. Treasury yields influence both.

As discussed in the 2022 article, plans like this are often appropriately thought of as having roughly zero overall Treasury rate duration. When Treasury yields rise, higher assumed ICRs increase projected benefit payments, but a higher discount rate reduces the present value of those payments. The two effects generally offset each other. Credit spread exposure, which also flows through the discount rate, is a separate risk and is addressed independently.

ICR Floors and Caps Introduce Option Value

A floor on the ICR changes this dynamic. Many cash balance plans also designate a minimum ICR in each period (e.g., 4%). Economically, this floor adds option value to a liability, and it is easy to miss. Each year's interest credit is the greater of the formula rate and the floor, so the non-retiree participants effectively hold a put option on the reference yield for each future year with the floor as the strike. The economic value of those options depends on how far the forward reference yield sits from the floor, the time remaining and the expected rate volatility. If a valuation relies on a long-term ICR assumption that is equal to the floor, for instance, it would not be accounting for the economic value of the floor, let alone the associated economic risk. In NISA's experience, many actuaries have recently sought to increase their long-term ICR assumptions in recognition of this economic value.

Prior to 2022, it was common for these plans to reasonably assume that the ICR was essentially fixed because rates were so far below these floors and, therefore, projected benefit payments were not sensitive to rate changes. However, these projected payments were still discounted based on prevailing market rates. Therefore, the liability still had duration. Today's ICRs are generally well above these floors, so the plans behave more like a traditional cash balance plan with no floor.

A floor that is out of the money is neither worthless nor static. If yields fall back toward the floor, the ICR stops declining while the discount rate continues to fall, so the liability becomes more sensitive to rate declines. A hedge calibrated when the floor is far out of the money can therefore understate the exposure just as it begins to matter. In practice, the plan sponsor is short an option, and hedging it means adding duration as yields fall.

Although less common, some plans also include a cap on the ICR, which works in the opposite direction. If yields rise far enough to reach it, the ICR stops rising while the discount rate continues to rise, so higher rates no longer increase projected benefits. The liability then takes on positive duration again, which means the hedging portfolio may need to add duration back as yields approach the cap.

Figure 1: Liability Behavior by Floor Regime

Regime	ICR Behavior	Liability Behavior
Floor binding	Fixed at the floor	Behaves like a fixed benefit with full discount-rate duration
Near the floor	Partially responsive to yields	Duration shifts as yields move; hedge ratios drift
Floor out of the money	Tracks the reference yield	Roughly zero overall duration; key rate exposure dominates

Source: NISA.

Changes in Yield Curve Shape Interact with Key Rate Exposure

Having briefly addressed the sensitivity of CB plans to the overall level of interest rates (duration), we must also consider the shape of the yield curve. CB liabilities often have material exposure to changes in the shape of the yield curve (ICR key rate sensitivity), despite having zero overall duration when there is no floor or similar feature.

The reason is a mismatch in where each effect is concentrated. Discount-rate sensitivity is spread across the curve, in proportion to when benefit payments are expected to occur. ICR sensitivity can be more concentrated, as it is tied to the tenor of the reference yield. For example, with an ICR based on 30-year Treasury yields, the benefits are economically tied to the 30-year rate at each reset date in the future. While a parallel shift causes the discount rate and ICR impacts to offset each other, a change in the slope does not. If forward 30-year yields rise while shorter yields are unchanged, the expected ICR rises on every future credit, but the discount rates applied to most payments barely move, and the liability increases. The reverse is also true.

In key rate terms, the liability carries negative sensitivity near and past the ICR reference tenor (see Figure 3) because it rises when that yield rises but has offsetting sensitivity at the tenors where benefit payments are discounted. The size of the exposure depends on the plan's demographics and the ICR formula. Younger participants have more years of future credits, and a formula that averages or lags the reference yield spreads the exposure over time.

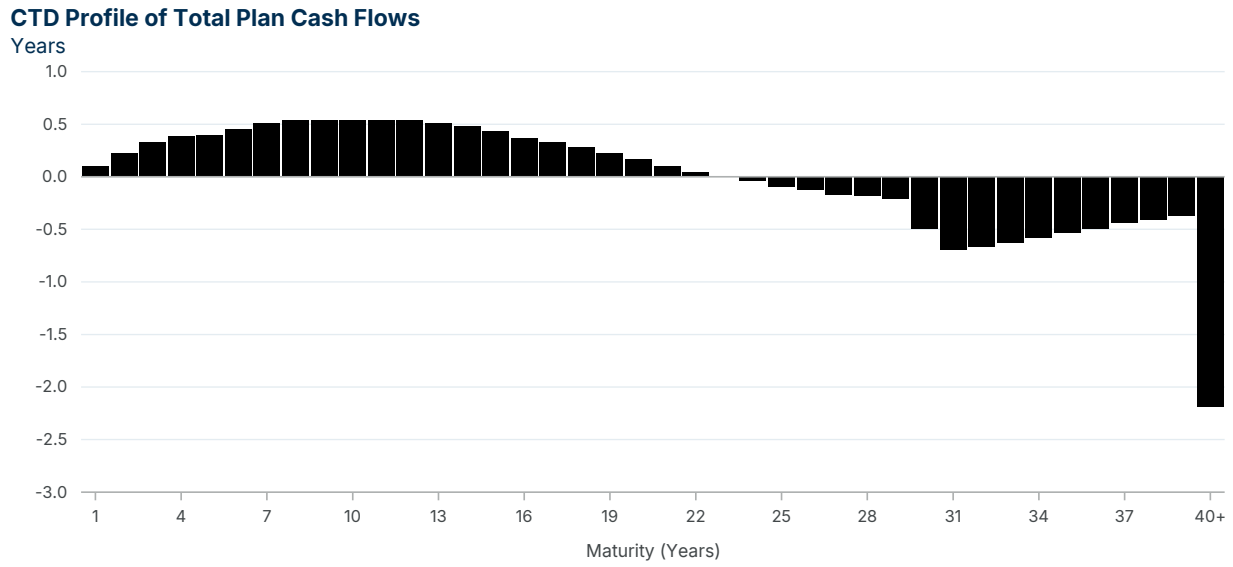
At today's level of rates, curve volatility makes this exposure more important than it was in 2022. At that time, the dominant story was the rapid rise in the level of yields, and many plans were only beginning to move through their floors. Since then, the curve has moved through deep inversion and re-steepening, and long-term yields have often moved independently of shorter yields. Because a CB plan with an out-of-the-money floor has roughly zero overall duration, a hedge against the level of rates leaves little to hedge. What remains is slope risk, so the plan's rate volatility is largely the volatility of the curve's shape. Higher rate volatility also increases the value of the floor, which makes the nonlinear effects discussed earlier more costly to ignore.

Figure 2: Liability Impact by Rate Scenario (Floor Out of the Money)

Rate Scenario	Net Liability Impact	Driver
Parallel shift in yields	Little change	Higher ICR offsets higher discount rate
30-year yield rises relative to shorter yields	Increases	ICR rises on all future credits; most discount rates change little
30-year yield falls relative to shorter yields	Decreases	ICR falls on all future credits; most discount rates change little

Source: NISA. Assumes the ICR is tied to the 30-year Treasury yield and credit spreads are constant. Assumes that the forward 30-year yields move similarly.

Figure 3: Illustrative Liability Impact by Rate Scenario (Floor Out of the Money)



Source: NISA calculations. Illustrated based on a flat discount curve with no spread. Illustrative static cash flows are based on a duration of 8.1 years. Cash flows are assumed to be projected on a forward-implied basis bootstrapped from the underlying Treasury curve. Contributions to duration (CTDs) are shown on a zero-duration basis.

Effective Hedging Addresses Duration and Curve

Hedging Treasury rate exposure embedded in CB plans requires addressing two intertwined but distinct risks: duration risk and ICR key-rate sensitivity.

Given the ICR applies to credits earned in future years, the liability is sensitive to the prevailing yields when those credits are set, not just to today's reference yield. For example, a credit earned in five years depends on the 30-year yield at that time, i.e., a forward rate. That forward rate is determined by two points on today's curve: the longer-dated yield that reaches the end of the forward period and the shorter-dated yield that reaches its start. Depending on the valuation methodology, projected ICRs may follow the forward or current yield, so the assumption used by the actuary should be confirmed when constructing the hedge.

Because the liability's sensitivities have opposite signs at different points on the curve, an adequate hedge may require a combination of long and short positions. The liability falls when yields rise at the tenors where benefits are discounted, so the hedge needs long positions at those

tenors. Conversely, the liability rises when the ICR reference yield rises, so the hedge needs short positions based on that tenor. Against this backdrop, the following principles should guide the construction of an effective hedge.

- Rather than a single duration number, use the plan's actual ICR formula, floor and/or cap, and any other relevant features to measure interest rate sensitivity.
- Consider full revaluation across rate scenarios, as linear duration measures may not fully capture the nonlinear effect of the floor.
- Pair the discount-rate hedge with targeted exposure at the ICR reference tenor, so the hedge gains when the liability rises with the ICR.
- Choose efficient hedging instruments and build infrastructure that lets the hedge adjust as the floor moves closer to the money.

Leaving curve risk unhedged matters more than it may appear, for several reasons:

- It's uncompensated. Absent a view on the term premium, the plan does not receive an expected return for carrying it and, with efficient instrument selection, it can be inexpensive to hedge [2].
- It's a compounded mismatch. A hedge built only on overall duration can hurt funded status when yields rise at the ICR tenor relative to other points on the curve. The two exposures offset in a parallel move, but a slope move in one direction hurts both at once.
- It's proportionally larger in well-hedged plans. Once the level of Treasury rates and credit spread exposures are hedged, curve risk can be a large share of what remains.
- It's difficult to explain. A funded status move the hedge does not explain is the kind of question plan sponsor stakeholders should ask.

Managing Curve Risk Supports More Stable Funded Status

Hedging Treasury rate exposure embedded in CB plans requires addressing two intertwined yet distinct risks: duration risk and ICR key-rate sensitivity. An integrated LDI approach supplemented with targeted Treasury exposure can reduce funded status volatility and contribution uncertainty. The appropriate hedge depends on the plan's specific crediting rate formula, liability profile and sponsor risk tolerance [3]. Plan sponsors with questions about whether their hedging program fits the features of their cash balance liabilities should consult their actuary, consultant or other advisors.

[1] There can also be duration impacts if the conversion between the CB lump sum and the annuity option is not market-linked.

[2] The cost to hedge varies with the instrument. The use of derivatives introduces additional requirements and risks to the portfolio.

[3] Hedging cash balance liabilities involves risks and limitations. These include actuarial risk (projected crediting rates, assumptions or participant behavior may differ from actual experience), yield curve risk (a hedge may not offset the liability across the curve) and, where derivatives are used, margin, collateral and operational risk. A hedge can lose value, and hedging does not eliminate funded status volatility or contribution uncertainty. Costs vary by instrument and implementation.

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